Railway Mechanical Engineer

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Railway Mechanical Engineer

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Casehardening valve motion parts

The even distribution of steam in the cylinders of a locomotive depends on the proper functioning of the valve motion which, in turn, depends largely on the amount of wear in the pins, bushings, etc., of the gear. The wear of these parts varies, other conditions being equal, to the degree of their surface hardness. The carburization and casehardening of valve motion parts is the key to the situation which is clearly set forth in an article on this subject that appears elsewhere in this issue. There are still many shops and enginehouses that use the old fashion method of casehardening with potash, which hardens only the skin of the parts and does not penetrate into the metal. As a result, regardless of lubrication, the parts wear quickly which soon leads to the improper functioning of the motion.

The installation of a highly developed system for casehardening valve motion parts would eliminate this trouble. First, there should be installed at the larger shops of the railroads a modern, electrically controlled furnace for casehardening. Those who operate the furnace and are in charge of the work should have complete information pertaining to the subject. With the right equipment and properly trained men in charge a system of production can be worked whereby every locomotive repair point on the road may carry in stock valve motion parts properly hardened ready to be touched up on a grinder and applied to the locomotive. Hit and miss methods of heat treatment in railroad shops have passed by and are being rapidly superseded by equipment and practices which produce accurate results.

High purity oxygen economical

The railway industry is a large consumer of oxygen but is it adequately informed of the fact that the higher the purity of the gas, the more economical is its consumption? This fact, along with many other interesting characteristics of oxygen are clearly set forth in an article on the economies effected by the use of high purity oxygen which appears on another page of this issue. It is pointed out that as the purity of the oxygen increases, the consumption and cutting time decreases. Take for example, the cutting of ⅜ in. steel, using 100 cu. ft. of 99.5 per cent oxygen as a basis of comparison. By reducing the purity to 99.0 per cent the consumption is increased to 114.1 cu. ft. Thus, a cylinder containing 200 cu. ft. of 99.0 per cent oxygen would yield, in reality, only 171.8 cu. ft. A car shop using 50 cylinders of 99.0 per cent oxygen a day would lose a potential consumption of 1,410 cu. ft. which would otherwise be available by using 99.5 per cent oxygen. Figuring on a basis of 26 working days a month, a total of 36,660 cu. ft. of the gas, or 183 more cylinders are consumed than would have been necessary by using 99.5 per cent oxygen. This means that 183 more cylinders of oxygen would have to be purchased or, figured on the basis of $1.50 per cylinder, a loss of $274.50.

Now let us turn to the savings effected in the cutting time by using higher purity oxygen. The time required to cut a given length of ⅜ in. steel using 99.5 per cent oxygen is 74 min. and 18 sec. To cut the same steel using 99.0 per cent oxygen requires 84 min., 45 sec., or a difference in time of 10 min., 27 sec. By using 98.5 per cent oxygen, the cutting time is increased 19 min., 6 sec. above the time required for the 99.5 per cent gas. Thus it can be readily seen that a large amount of time would also be lost daily by using oxygen that was not up to a high standard of purity. Since small increments of change in the purity of oxygen have a marked effect on operating costs, the railroads should establish a standard of purity and religiously adhere to it when purchasing oxygen.

Anti-friction bearings for railroad equipment

The demands on a railway car journal are of an exacting nature and they will become more so as cars of greater capacity are built. The problem of increased train tonnage is gradually reaching the stage which will eventually demand a reduction in journal friction. Experience in other industries has indicated that ball bearings can carry comparatively heavy loads at reasonably high speeds, but in order to be successfully applied to railway rolling equipment, ball bearings will have to be of dimensions which are quite impracticable. The roller bearing was developed in the search for an anti-friction bearing that would carry heavier loads. In recent years, we have seen various modifications of both the ball and roller bearings as well as designs involving combinations of the two.

The conditions under which railroad equipment will be operated in the future will demand a journal bearing having a minimum of friction, capable of handling both radial and thrust loads, and easy to maintain; that is, have no loose parts and be capable of quick inspection.

A number of attempts have been made to apply both ball and roller bearings to car journals. However, the capacity of these bearings over the static load was not sufficient to give the long life necessary to economical car maintenance. The greater number of tests of anti-friction journal bearings have been performed on European railway equipment, which is considerably lighter than that used in this country. However, considerable data of value have been obtained as a result of these experiments. The Swedish State railways have conducted a number of experiments with an especially designed shock absorber and data have been collected as to the radial and lateral shocks incurred by a car journal box in actual service. Undoubt-

edly this progress in anti-friction journal bearing design will become as important to the car designer as the three-cylinder or steam turbine developments have been to the locomotive designer. The mechanical engineer employed in the design and maintenance of railway rolling equipment should watch closely the further development of anti-friction journal bearings.

Are brains an asset?

Word was recently passed along the line on a certain railroad that one of its shop superintendents was slipping. An extensive area of the top of his desk had recently begun to show through the piles of correspondence with which it had once been covered. Furthermore, on several occasions he had been found in his office doing nothing, apparently thinking intently. The fears for this officer's future which have begun to find lodgment in the minds of other officers and men up and down the line, and the facts on which they are based are significant. It may be inferred, first, that unless the desk of a minor managing officer is not buried in correspondence, he is not as busy as he should be; and, second, that with no evidence of industry before him, he should never be found sitting at his desk. Apparently he should be seen hurrying from place to place in the shop demonstrating his superior ability by "bawling out" his foremen for their shortcomings. Undoubtedly there should be a place in every superintendent's daily schedule for a personal inspection of the operations over which he has general supervision. With a good organization and competent foremen, however, this need not occupy all or even a major part of his time. Time spent in quiet reflection on the problems of more and cheaper output need by no means be considered as wasted. Men must have four personal instruments with which to make themselves useful; their hands, their feet, their mouths and their brains. The mechanic's usefulness lies largely in the skill with which he can use his hands. It is being recognized more and more, however, that his brains are an asset which also ought to be utilized. The foreman is expected to use his feet and his mouth, the skill and tact with which he uses the latter instrument largely determining the quality of his personality. Here, again, the value of brains in directing the feet and the mouth is constantly receiving more recognition in the attention which is being given to the better selection and training of these direct supervisors. But in the case of an officer who may be responsible for the results of the labor of several hundred men, using several million dollars' worth of facilities, the attempt to make a little more intensive use of his brains in constructive planning than is expected of the mechanic or the foreman should not excite unfavorable comment. If brains are valuable, why not give a little more scope to their activity where it will accomplish the biggest results?

Foreman training

The *Railway Mechanical Engineer* has had much to say in recent years about the necessity of special coaching and training of foremen and supervisors in the art of leadership. It is essential, if the railroads are to be operated economically and efficiently, that there be intelligent and enthusiastic co-operation on the part of all the workers—supervisory and in the ranks. This objective, however, cannot be attained if the foremen and supervisors are indifferent or if they do not have a keen appreciation of the importance of the human element in the organization.

The truth of this has been steadily growing in the consciousness of railway managements in recent years and is indicated in many ways. A notable illustration of this interest is contained in the annual report of the Boston & Maine for the year 1924. This report contains several paragraphs relating to relations between the employees and the management and includes this significant statement: "Educational work of a practical nature has been extended during the year, as opportunity would permit. The foremen's clubs in the mechanical department, organized last year at several points, have been extended over the system and are discussing problems of proper supervision as well as of shop practices, with increased attendance and interest."

Clubs of this sort naturally function best during the winter months, although much can be done among the foremen along educational lines during the entire year. Foremen's clubs of various sorts have functioned to advantage on several railroads during the past year. Attempts to develop such clubs, on the other hand, have failed or have had little results in other places. The importance of the question has been entirely overlooked on not a few railroads. Now is the time to take stock and to consider what steps should be taken to promote this constructive development next year. Why has the movement failed on some roads and been a notable success on others? The foremen are the liaison officers between the management and the men and they can immensely improve an organization or greatly weaken it, depending on whether or not they have a large appreciation of their responsibilities and utilize every advantage to inform themselves as to the best ways of successfully discharging their difficult responsibilities.

Here is another significant quotation from the Boston & Maine report: "It (the management) would fail in its duty alike to the property, to the public and to its own organization if it were to regard the building up of an effective co-operation as of less consequence than the technical problems of operation, maintenance and finance. Urgent as these problems are, under all circumstances, it remains permanently true that the labor and supervision cost is the largest item in the budget, and justifies, for this reason alone if on no broader grounds, special attention to the proper basis for a service distinguished by voluntary interest and good will rather than a mere perfunctory discharge of assigned duties."

Apprentice conferences

Readers of the *Railway Mechanical Engineer*, and its predecessors, have noted not a few times during the past 15 years, reports of system conferences of apprentice instructors. A rather unusual development which has taken place within the past year has been system gatherings of apprentices or younger railroad employees. The Santa Fe had a system apprentice conference at Albuquerque, N. Mex., in March, 1924; it was promoted by some of the boys who attended the first Railroad Younger Men's Conference of the Y. M. C. A., held in St. Louis near the end of 1923. The second apprentice conference on the Santa Fe was held at San Bernardino, Cal., February 19-21 of this year and was attended by 150 picked young men who were sent as delegates from the apprentice clubs on the system. These clubs are maintained by the boys themselves, for their physical, mental and moral development and improvement. The three-day program included reports and discussions on the activities of the various clubs and as to how to make them more effective. The delegates, upon their return home, reported orally to their local clubs and presented written reports of their observations to the local master mechanic or superintendent of

shops. The general results were summed up as follows in an article in a recent issue of the Railway Age: "It is difficult to estimate the good derived from a meeting of this kind. Certainly leadership was developed. Each delegate returned to his home station with a greater love for the work of his trade, a greater appreciation of the plans and purposes of the railway management, and a greater conception of the nobler things of life, a greater degree of co-operation with officials and fellow employees, and a greater determination to make the best of every opportunity offered."

The Chesapeake & Ohio has just held a similar system conference at Huntington, W. Va., but including representation from all of the classes of boys and young men on the railroad, although the larger proportion of the delegates came from the mechanical department apprentices.

The Younger Railroad Men's Conference of the Y. M. C. A. held a second meeting at Detroit last November, at which 279 young men were present, representing 48 railway systems, from 33 states and provinces, and 58 different classifications of occupations.

It will be interesting to watch the development of this new movement and try to trace the beneficial results which will come from it. It would seem that the young men would gain a far greater appreciation of the importance of the railroads from an economic point of view and that they would be inspired to take a larger and more intelligent interest in their work. Instances are already on record where young men going home from these conferences have had a strong and beneficial influence upon their comrades who were not so fortunate as to attend the conference. In applying scientific methods to improve the morale in the army in recent years, a new slogan has been adopted—"The Army Builds Men." The objective is to develop each man in the organization to the fullest extent of his ability. This new movement among the younger men on the railroads would seem to tend in the same direction and should result in getting the young men into that particular class of work for which they are best suited, in making them more happy and contented in their work, and in fitting them to carry larger responsibilities in the future.

Air compressor misalinement

The standards of air compressor maintenance should be kept as high as possible. One of the details which probably gives more trouble than any other single item is inaccurate alinement of the cylinders which may be due to any one of a number of conditions. Whatever the reason, the result is the same—decreased air compressor efficiency, shorter compressor life, increased failures and generally increased operating costs. The following are some of the observed results: Misalinement sometimes causes reversing valve rod chatter, resulting in failure due to a crystallized and broken valve rod. Misalinement causes the pistons to bind and wear on one side at the bottom of the stroke and on the opposite side at the top of the stroke. This binding will continue until the cylinder walls and pistons are worn enough to give free travel; the result is out-of-round cylinders and pistons with excessive clearance and ring gap. Continual binding may also result in the pistons becoming loose on the piston rods and the nuts coming off.

There are cases where the piston has stayed tight on the rod but the continual binding action has crystallized the rod with the result that it snapped off close to the piston. Misalinement causes the piston rings to shift continually in the piston, resulting in undue wear of the rings and grooves and permitting the air to blow by, thus shortening the life of these parts as well as contributing to compressor inefficiency.

One of the greatest difficulties resulting from cylinder misalinement is packing trouble, caused by the side motion of piston rods. Stuffing box nuts must of necessity be drawn exceedingly tight to prevent leaks under this condition and the life of the packing is correspondingly shortened. The air compressor is subjected to continual laboring on account of the tight packing and naturally more steam is consumed in operating pistons that are so hard to move. This excess packing pressure greatly increases wear on the piston rods which is also undesirable.

Fortunately these difficulties can be entirely overcome. Several machines, both grinders and boring machines, are fitted with revolving indexing tables and there is no reason why the same principle may not be adapted to others. With the pump mounted on the indexing table the cylinders may be bored without breaking the joints between the cylinders and the center castings. After boring one end the table may be revolved and accurately set at 180 deg. from its original position, which removes all guess work as to the accuracy of alinement of the cylinders.

Since the misalinement of air compressor cylinders is responsible for so many evils as outlined, it behooves shop superintendents, air room foremen and others responsible for the work of repairing air compressors to check their practice in this respect. If they are having difficulties, probably the method mentioned may solve the trouble.

New Books

MASTER BLACKSMITH'S PROCEEDINGS. *Edited by William J. Mayer, Secretary, 2347 Clark Avenue, Detroit, Mich. 133 pages 5½ in. by 8 in. Bound in Cloth.*

Those interested in the methods employed in the manufacture and repair of car and locomotive parts in the blacksmith shop should obtain many helpful suggestions from the papers contained in this report of the proceedings of the twenty-eighth annual convention of the International Railroad Master Blacksmiths' Association, held at the Hotel Sherman, Chicago, August 19, 20 and 21, 1924. Considerable attention is given to the manufacture and repair of frames, springs, draw bars and pins. The book is well illustrated.

TRAVELING ENGINEERS' ASSOCIATION. *Edited by W. O. Thompson, Secretary, Cleveland, Ohio. 386 pages, 5½ in. by 8½ in. Bound in Cloth.*

A wealth of material of interest to traveling engineers, road foremen of engines and others, is contained in this report of the proceedings of the thirty-second annual convention of the Traveling Engineers' Association, held at Chicago, September 16, 17, 18 and 19, 1924. Following a list of the 1924-1925 officers in the front of the book is the constitution of the Traveling Engineers' Association and a brief report of the subjects considered at each convention since the first held at Chicago in 1893. The report of the convention is divided into seven parts, one for each session. Among the nine papers read during the convention were those dealing with the following subjects: Conservation of locomotive fuel; Lubrication and its effect on locomotive service; Locomotive boosters and their effect on locomotive design and train operation; Relation between terminal facilities and locomotive service; Automatic train control devices. These papers have been for the most part, printed in abstract in the

Railway Mechanical Engineer. A comprehensive index in the back of the book enables any of the papers as well as the discussions by the various members, to be located readily.

What Our Readers Think

What advantages have floating bushings?

San Antonio, Tex.

To the editor:

Will you please advise what advantage floating bushings on back end main rods and middle connections have over the solid stationary middle connection bushing and the old style two-piece back-end brass? I have in mind heavy power, with 25 in. by 30 in. cylinders. These rods develop a pound in five to ten thousand miles and run very hot even after 90 days' wear.

The information desired is, what are the advantages of floating bushings for heavy power and are they more economical than the old style referred to? S. J. Stark,
General roundhouse foreman, International-Great Northern.

Question pertaining to the wear of locomotive air compressor cylinders

Lincoln, Neb.

To the editor:

It has come to my attention recently that the air cylinders of 9½-in. and 11-in. air pumps wear most at the end while the air cylinders of 8½-in. compound pumps wear most near the middle. The first case is not uncommon, but the latter appears to me as a rather unusual place for the cylinder walls of compound pumps to wear as they are more evenly balanced in their action than the single acting pumps.

I would like to see published in the columns of your magazine an explanation as to why air pump cylinders wear in this manner, and also if there are any possible means of overcoming this trouble. R. J. K.

Derailments of locomotives—a criticism

Philadelphia, Pa.

To the editor:

I think you have met the needs of many master mechanics and motive power men in the article on the derailments of locomotives on curves, published in the December, 1924, and January, 1925, issues of the *Railway Mechanical Engineer,* quite creditably. The authors have given an interesting picture of the tracking of a locomotive around a curve.

In the tracking of a locomotive around a curve, knowing the extent of both the flange and hub plays, the elevation of the outer rail, the speed and center of gravity of the locomotive and the drawbar pull, assuming that the locomotive is equipped with flat tires, and accurate data is available relative to the truck hangers and back lash of the truck, only one assumption is needed for the determination of all the forces, and that is the co-efficient of friction at the various wheel contacts with the rail. Several trial assumptions of the center of rotation or friction center will facilitate a solution of the general equations, but there is only one center of rotation which will satisfy the center of rotation of the wheel base. It is interesting to know that the center of rotation can be determined experimentally. This was actually done on the Chicago, Milwaukee & St. Paul's electric locomotives and with all the above data available, the computations checked fairly accurately with the actual test loads, etc.

A moment's inspection of Fig. 5, which is shown on page 17 of the January, 1925, *Railway Mechanical Engineer,* will show that the forces considered are inconsistent with the condition of kinetic equilibrium and that a very important reaction has been omitted in the analysis; that is, the reaction of the inner rail on the fourth driver outwards. No assumption is needed for the friction center, though trial values would facilitate the solution of the equations. Moreover, if traction is assumed, the friction center would probably lie beyond the outer rail, while without traction on the curve, the center of rotation must lie along the center line of the locomotive. The assumption of the main driving axle for the position of the friction center is possible, though my trial value would be at first, at the fourth driver.

In the configuration diagrams of the wheel base on a curve, the diagrams indicate a swing of the trailing truck comparable to the swing of the engine truck. This is, of course, due in greater part to the assumed forward position of the center of rotation. It is interesting to note, however, that the swing of the trailing truck is but from one-third to one-half of that of the engine truck.

One serious objection to this article is the lack of the use of some exaggerated graphical method for giving the configuration on the track as is given by the Roy diagram. Then too, no consideration is given to flange and hub plays which have an erroneous bearing on the configuration of the wheel base, especially in such types as the Santa Fe locomotives.

The analysis of the reactions of the truck are in error, due to failure in considering the lateral thrust at the center pin bearing U. Thus the vertical forces should be

$$Z_1 = \frac{Z\,s}{r+s} + \frac{U\,h}{r+s}\,;\; Z_2 = \frac{Z\,r}{r+s} - \frac{U\,h}{r+s},$$

where h is the height of the horizontal component at the pin above the point of contact of the rockers on the inclined planes. The co-ordinates r and s are poorly chosen. They should be at some fixed point such as the bottom bearings or at the center between the bearings of the rockers.

The resolution of the forces for the wheel contact with the rail is incorrect. It should be remembered that the friction component has its horizontal component as well.

I think the article meets its purpose very well indeed and should give the majority of your readers an interesting insight as to the nature of the tracking of a locomotive around a curve. The analysis of the factor of wheel bearing has not been sufficiently extended for me to give any further comment on this particular phase.

The Roy diagram offers such a satisfactory method for the real understanding of the tracking of a locomotive, even from a practical point of view, that it is suggested that this method be given consideration.

R. Eksergian,
Baldwin Locomotive Works, Philadelphia, Pa.

The answer

Greenville, Pa.

To the editor:

Relative to the outward reaction of the inner rail on the fourth driver, I formerly held the same opinions as Mr. Eksergian. This reaction was taken into account at the

time of the original investigation in 1919. From the configuration diagrams which we made at that time, and from our analysis of the problem, we were led to believe that such a reaction existed. Since that time, I have frequently noticed that the driving wheels, both in cases of derailment and otherwise, did not line up on the track the way our configuration diagrams showed that they should. I have never seen the flange of the fourth driver in contact with the inner rail although particular pains were taken in various investigations to discover such a contact if there were any. That the inner flanges do not bear against the inner rail is further shown by the fact that on a wye which is used exclusively for turning Santa Fe locomotives, there is not the slightest sign of wear on the inner rail. These observations led to the conclusion that there is no outer reaction of the inner rail on the flange of the fourth driver of a Santa Fe type locomotive. It also shows as a corollary, that the center of rotation is at or ahead of the main driver, for otherwise, the clearance between the fourth inside driver flange would be taken up, which is contrary to fact. The resolution of the forces and the determination of the center of rotation, in our article have been made to agree with our observations of tracking conditions as they actually existed on a certain road.

In regard to the configuration diagrams showing the swing of the engine and trailing trucks to be about equal, I am inclined to think that this is about right. If the swing of the trucks is about equal, the center of rotation must be approximately at the center of the locomotive, that is, if the radius bars are about the same length. Conversely, if the center of rotation is at the center of the locomotive, we would expect the swing of the trucks to be about equal. In the case of the Santa Fe type locomotive, used as an example in the article, the permissible swing of the leading truck is 4½ in. each side of the center, and the permissible swing of the trailing truck is also approximately 4½ in. each side of the center of the truck.

An examination of a number of locomotives of this type revealed that the frames had been severely punished by the trailing truck wheels. They frequently came in from their runs with the frames worn bright. There is nothing to show that the 4½-in. permissible movement of the engine truck is not sufficient. I take these facts to indicate that the swing of the trailing truck is as great as that of the engine truck which simply confirms in another way the conclusion that the center of rotation is at or ahead of the main driver. It is interesting to know that U. S. R. A. 2-10-2B type locomotives do not give any trouble in this respect as they have approximately 8-in. permissible movement of the trailing truck on each side of the center.

Relative to the omission of a consideration of the lateral thrust of the center pin bearing, it is agreed that such a force exists and the omission is acknowledged. This force has been analyzed and used in a number of investigations, but we neglected to take it into account in this instance. This is the force which causes the couple shown in the sketch published in the answer to a question on this subject on page 138 of the March, 1925, *Railway Mechanical Engineer*. However, in reference to the quantities r and s, these are not co-ordinates, but simply moment arms of the vertical force Z which shows that the proportions of Z are resisted by the reactions at different ends of the bolster.

The friction component normal to the side of the rail head was taken into account as well as its vertical component in the resolution of forces for the wheel contact with the rail.

The Roy diagram will give the configuration on the track from the geometrical standpoint from which the flange and hub plays and other characteristics may be easily worked out. But in this case, we have assumed that the tracking is all right and are solving for the nature and intensities of the forces necessary to turn the locomotive against friction. Of course, if a locomotive will not traverse a curve without binding, these forces will be altered in nature and increased in intensity. This, however, is outside of our problem. Flange and hub plays, aside from the fact that they must exist in sufficient degree to prevent binding, do not enter into the case. We are dealing with forces and reactions and the balancing of their moments. The fault that I have to find with the Roy method is that it assumes that the rear axle is radial to the curve, which I believe is erroneous, both from an analysis of the configuration and from actual observation of locomotives on curves. In the case of the Santa Fe type locomotive used as an example, proper tracking by the Roy method would doubtless be shown, but if it had more freedom of trailing truck movement it would be a better curving locomotive.

A proper solution of this problem should be of interest to many railroad men and the criticisms you have made are constructive and should be considered in future investigations.

Roy C. Beaver,
Assistant mechanical engineer, Bessemer & Lake Erie.

Old style hand brake wheels vs. new designs

Mobile, Ala.

To the editor:

It seems that there is an opinion abroad that the time has arrived when the hand brake wheel should be discarded and something new designed to take its place. There are a large number of innovations being put forward and the final outcome will probably be something with decided advantages over the hand wheel now generally used by the railroads.

In the meantime, there are several important points that should be borne in mind. When a hand brake is needed, it is very often more or less a case of emergency, as preventing a car rolling out of the clear, stopping it on an incline, letting it down an incline or for setting a certain percentage of brakes on a heavy train.

Many switchmen and trainmen do not take readily to new mechanical contrivances, and when it is necessary to stop a car quickly, the urgent need is for a brake with which no mistake can be made and which requires no fumbling and fooling in order to understand how to operate it. The old brake wheel certainly meets these requirements. I have asked many trainmen which of the new style brakes they like best. They usually don't know them apart, but often the answer is that some of them are good brakes if you know how to work them. Many trainmen heartily condemn all new styles. One serious objection to most of the new style brakes is that when the end of the car becomes bulged to any extent, the brake shaft supports are thrown out of alinement and it is impossible to entirely release the brake without the use of a wrench or some other similar tool.

The hand brake is too vital a thing to be experimented with extensively. If there is to be a new one it should be adopted and made standard so that all concerned could familiarize themselves with it so that parts could be kept in stock for making repairs, as a defective hand brake puts a car completely out of commission under the Safety Appliance law.

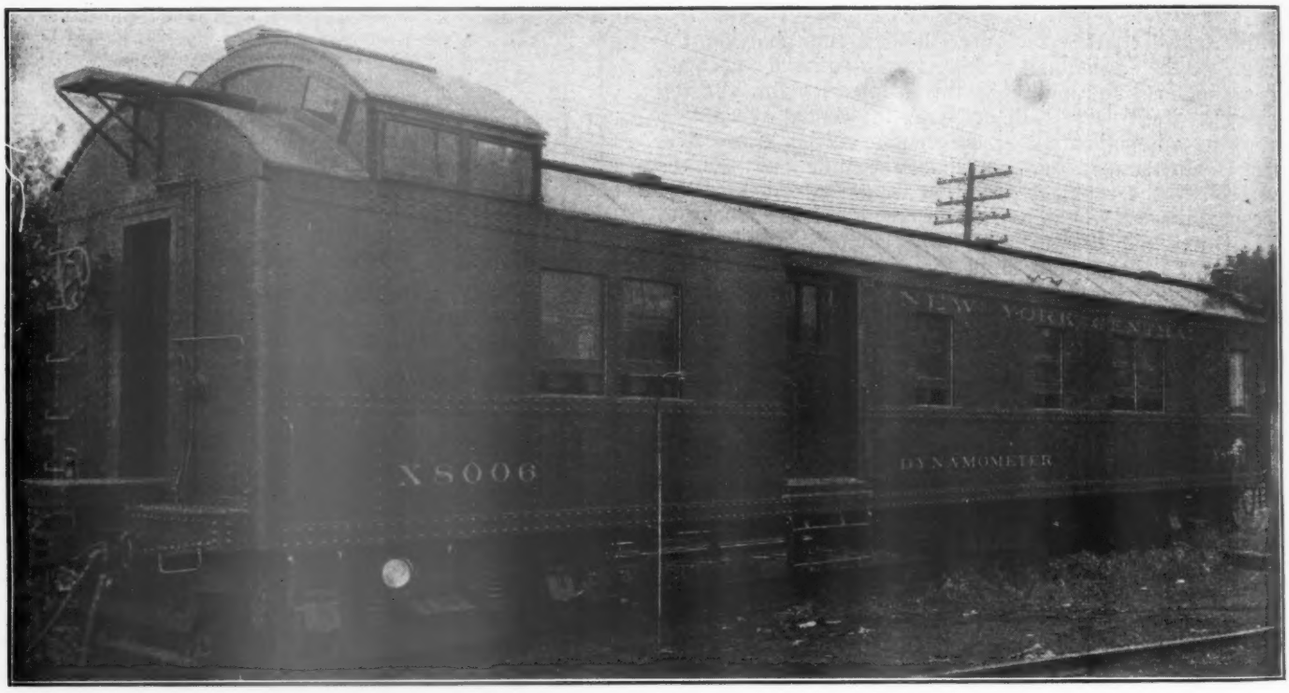
T. J. Lewis,
Car inspector, Southern Railway.

N. Y. C. all-steel dynamometer car

Complete facilities for obtaining a wide range of operating data are provided and conveniently arranged

THE New York Central has had a dynamometer car of all-steel construction in service for something more than a year. The car is unusually well equipped, and its accommodations are well arranged. It was designed under the direction of F. H. Hardin, chief engineer of motive power, New York Central, and the late F. S. Gallagher, engineer of rolling stock, and built at the West Albany shops of the railroad. The dynamometer apparatus was designed, built and installed by the Burr Company, Champaign, Ill.

The car has an inside length of 52 ft. 2-7/16 in. and an inside width of 8 ft. 8⅜ in. The dynamometer or office compartment occupies 21 ft. 6¾ in. of the length of the car, while the remainder is devoted to sleeping and dining



Dynamometer car built by the New York Central and the Burr Company, Champaign, Ill.

accommodations for the crew. As shown in the drawing of the floor plan of the car, accommodations are provided for a crew of seven men and additional accommodations can be provided for two more if necessary. The berth and dining compartment is accessible from both the kitchen quarters and dynamometer compartments. When desired it can be isolated from either end by closing the doors between the sections. Ample toilet, lockers and wardrobe facilities make the car convenient and practical for carrying on the work for which it was designed.

One of the features incorporated into the design of the car is the ⅝-in. steel floor plate which extends over the entire dynamometer end of the car. This plate gives added strength to the frame and assists in taking the high stresses incidental to the measuring of the draw bar pull and buff. Another feature designed for facilitating the work of the crew is the work table which is supplied with reels, interchangeable with those on the chronograph table. It has an approximately length of 12 ft. which permits the operating crew to analyze at one time the record covering a considerable extent of track. Connections to the train air line and brake cylinders are located in close proximity to the chronograph table so that the gages can be easily read. Locomotive steam pressure is carried back to a gage which is also located over the chronograph table.

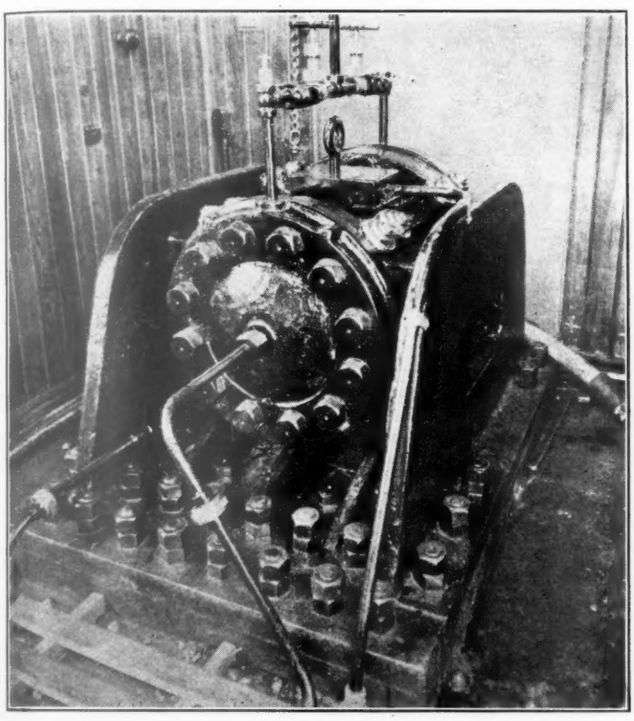
The dynamometer apparatus

The dynamometer has a capacity of 500,000 lb. maximum draw bar pull and a maximum buff of 1,000,000 lb. The apparatus provides facilities for taking 17 graphic records, two of which are for time intervals, which are recorded automatically and simultaneously on the traveling paper ribbon. There are also extra electric recording circuits which may be used for special records when desired. The traveling paper is sufficiently wide so that memoranda may be entered thereon in proper relation to the various graphic records, which are as follows: draw bar pull, draw bar buff train speed, train line air pressure, locomotive steam pressure, brake cylinder air pressure, time intervals, position of the locomotive throttle, locomotive reverse lever position, location of track curves, grades, power delivered through the drawbar to the train, train location, distance traveled, time indicator cards were taken, time and amount of firing the locomotive, and provisions for three unassigned records.

The dynamometer car recording equipment consists of a diaphragm dynamometer, a recording machine, an electric

system which includes only that used in connection with the recording apparatus and an axle drive transmission unit. The electrical equipment does not include that which is used in connection with the car proper.

The draw bar dynamometer consists of a standard draw bar fitted with a special yoke connected to the dynamometer weighing head. The weighing head is designed to receive the full pull or buff from the draw bar and



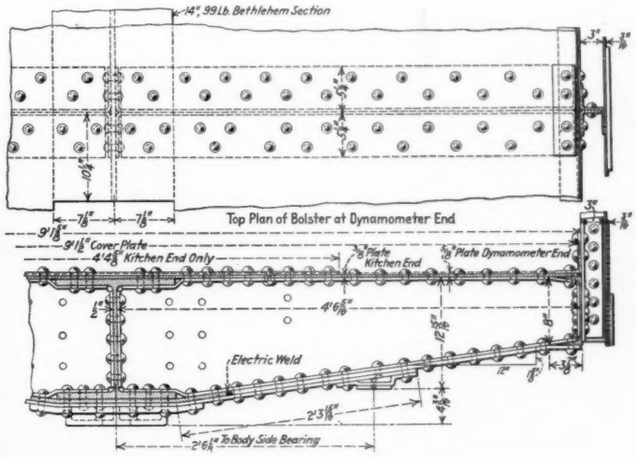
The dynamometer weighing head is designed for a drawbar pull of 500,000 lb. and 1,250,000 lb. buff

transmit the force by means of pistons to pressure cylinders. The forces are here converted into liquid pressure which is transmitted to the chronograph and automatically recorded in proper relation to the time and other records.

The dynamometer weighing head is equipped with locking devices for holding the piston inactive so that the car may be moved in an inoperative condition. It is mounted on the 5/8-in. steel floor plate in a rigid position so that it can take and record the maximum pull and buff without vibration or damage from sudden shock. The weighing head is also equipped with limit alarms to insure the floating action of the pistons. Special indicators are used for recording the draw bar pull and buff records. These are provided with a full set of reaction springs which cover the entire range of operations for which the car is designed.

The chronograph makes all of the records simultaneously on the traveling paper ribbon without interference or space corrections, with the exception of the five magnet records, which are placed back of the straight line chronograph record. The movement of the paper ribbon can be proportioned to the distance traveled or it can be run at a constant speed as desired.

Special pens are used for each chronograph recording

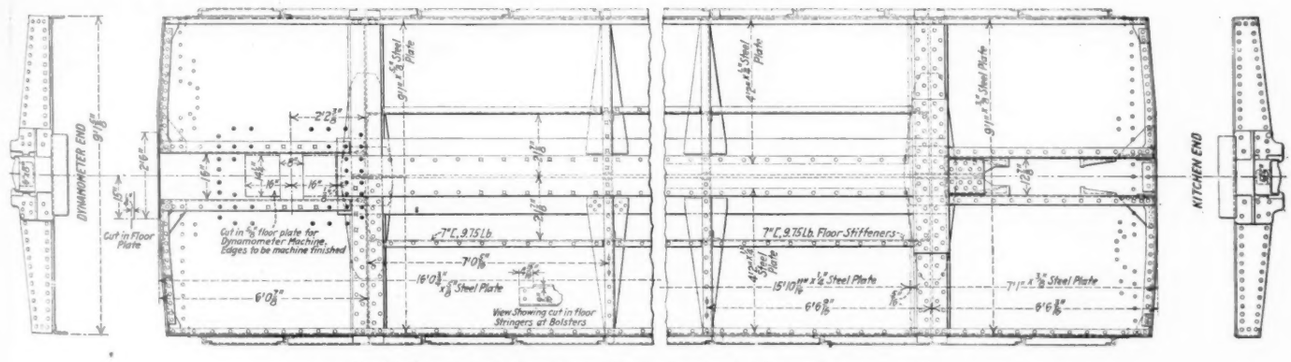


Drawing of the body bolster at the dynamometer end

instrument mounted on a rigid supporting arm which is controlled by the testing instruments. All the instruments, together with the indicating gages and magnet control circuits, are placed in such a manner as to be readily accessible to the operator, so that he may readily observe and control the chronograph record and make necessary memoranda on it.

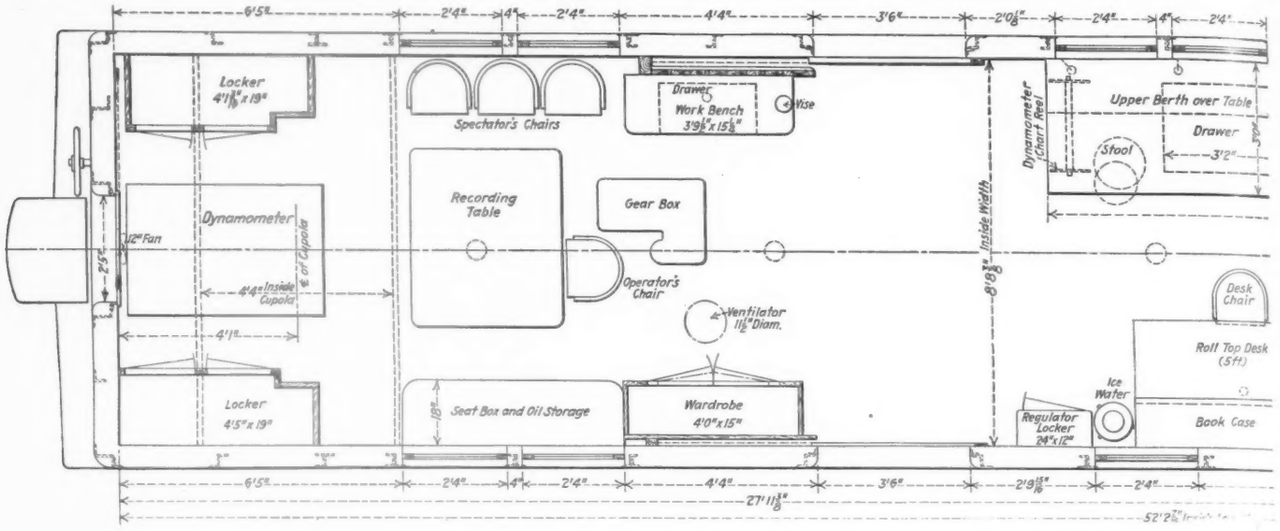
The driving transmission

The driving transmission includes a clutch control equipment for shifting the driving mechanism from the car trucks to an electric motor operated from the train line battery. It also includes the shift gears for changing the travel ratio of the paper ribbon and provides an automatic reverse drive clutch so that the paper will always travel forward regardless of which direction the car travels. The transmission gears are enclosed in a dust proof oil case of rigid construction. Bevel gears are used for connecting the drive to a telescopic torque shaft con-


DYNAMOMETER END
KITCHEN END
Cut in Floor Plate
Cut in 5/8" floor plate for Dynamometer Machine. Edges to be machine finished
7" C. 9.75 Lb.
7" C. 9.75 Lb. Floor Stiffeners
Steel Plate
View Showing cut in floor Stringers at Bolsters

Underframe of the New York Central dynamometer car

nected to the rear axle of the forward truck under the dynamometer end. This drive on the forward truck is also mounted in a dust proof gear case and is provided with a disengaging clutch for disconnecting the entire travel. A constant speed motor is used for the speedometer as well as for the purpose of keeping the paper in motion when the car is at rest. All the transmission levers, the motor rheostat and switches for the entire

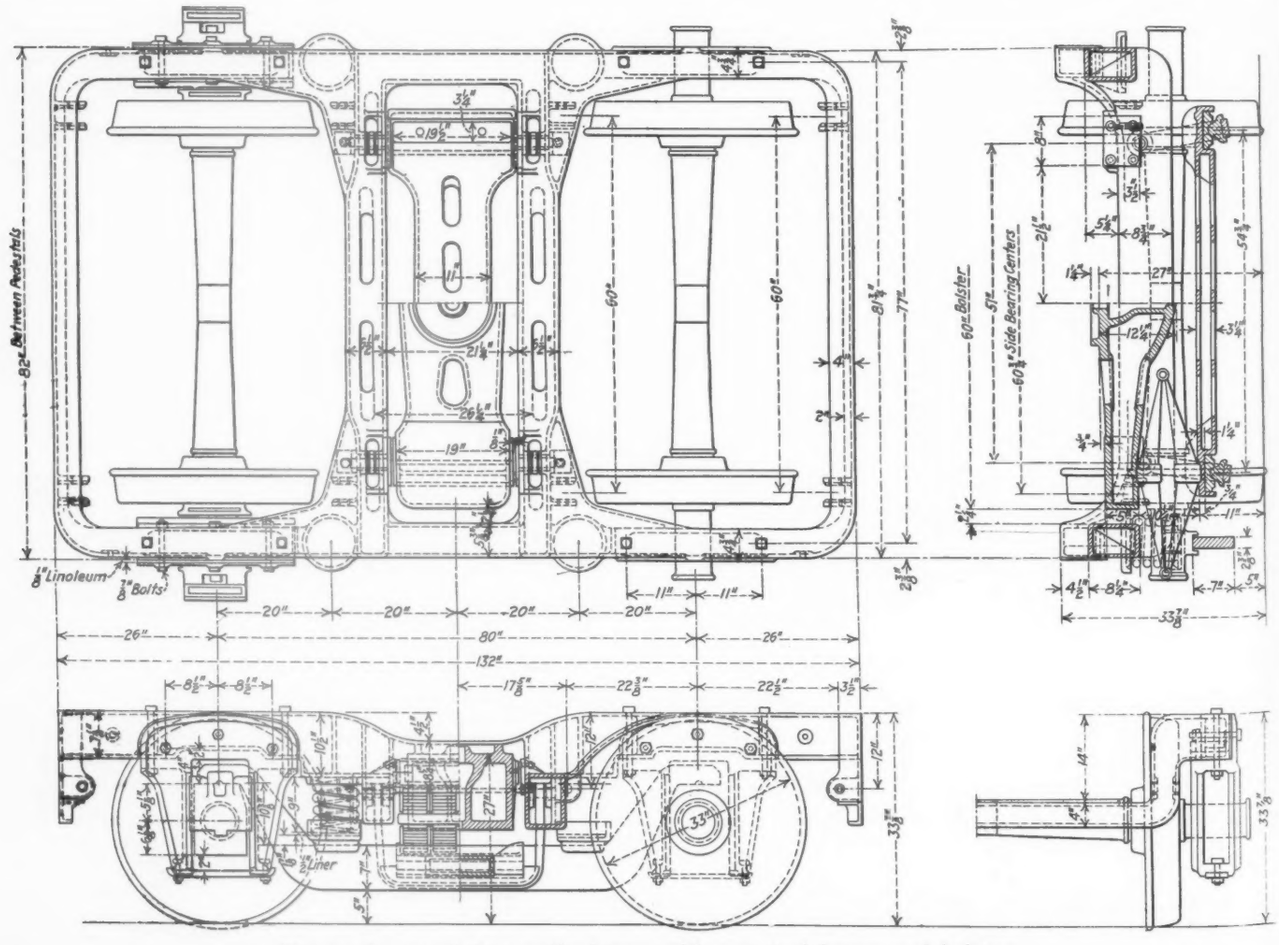


Floor plan of the dynamometer

gearing system when the car is being moved in an inoperative condition.

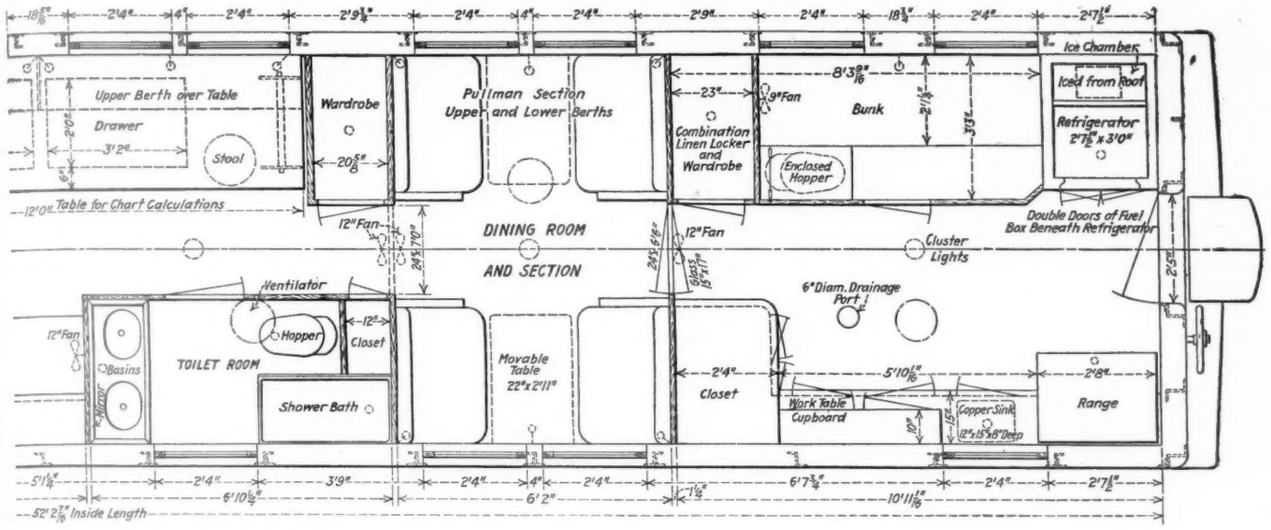
The distance timer, which is on the transmission unit, makes automatic electric contact for every 100 ft. of train apparatus are located within easy reach of the operator.

The kitchen is located at the opposite end of the car from the dynamometer compartment, as shown in the floor plan. It is equipped with a range, refrigerator,



The trucks are of the equalized type, with cast steel frames and bolsters

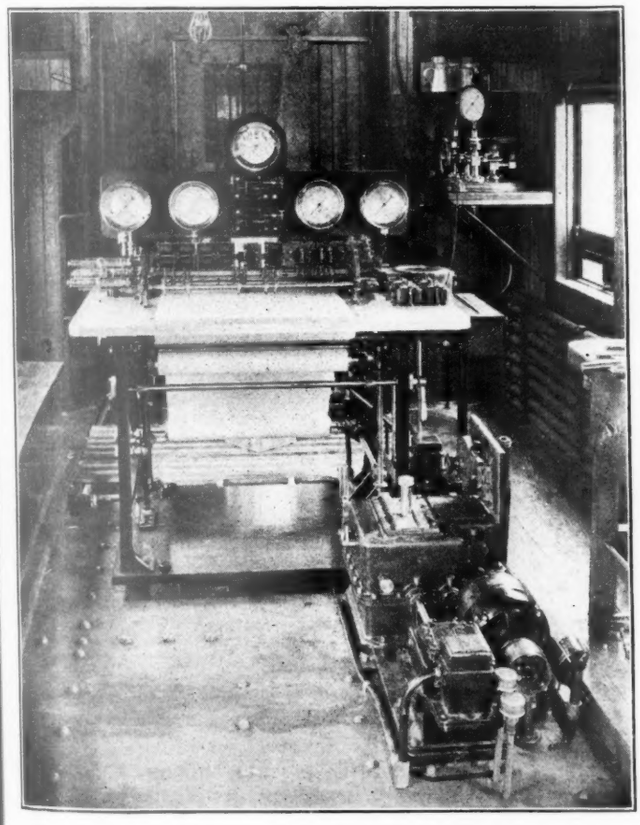
copper sink, work table with cupboards above and below, china closet, a fuel box which is located beneath the refrigerator, combination linen locker and a wardrobe compartment equipped with a bunk and enclosed hopper for calculations. The equipment in this section also includes file cases, stools, dynamometer chart reels, two upper berths, a roll top desk and chair, a bookcase and water cooler stand, drinking cup container and a wardrobe and



car built by the New York Central

the use of the porter who takes care of the car service.

The dining room section is provided with two Pullman sections of upper and lower berths and two removable



The dynamometer recording apparatus with the traveling paper in position ready for operation

tables. The section between the dining room and side doors, which is shown in one of the illustrations, is provided with a table, equipped with two drawers, for chart closet. The section between the side doors and the dynamometer end of the car is provided with a work bench, gage tester, gage board, vise, instrument board, chairs for spectators, lockers, recording table, dynamometer, and a chair for the operator.

Special features

The car is heated with the vapor system and is ventilated by means of five 6-in. Globe ventilators. The sides, end walls, cupola and roof sheets are insulated with a ½-in. thickness of special hair felt, applied next to the outside sheathing. Three ply hair and asbestos insulation is applied over the entire surface of the steel floor plates and to the inside surface of the outside sheathing and the under side of the bottom course of the flooring.

Current for the lighting equipment is supplied from a three-kilowatt low speed generator operated from the car axle. The lighting equipment can also be operated on battery discharge on layovers up to eight hours.

The water supply is contained in two overhead water tanks, located in the kitchen, one on each side of the car and formed to the contour of the roof. Each tank has a capacity of 100 gallons. These tanks can be filled simul-

General data and dimensions

Maximum draw bar pull	500,000 lb.
Maximum buff	1,000,000 lb.
Length, inside	52 ft. 2 7/16 in.
Length over platform end sills	55 ft. 0 1/16 in.
Length, center to center of trucks	42 ft. 5 in.
Truck wheel base	6 ft. 0 in.
Width over side sills	9 ft. 1 5/8 in.
Width over all at eaves	10 ft. 0 7/8 in.
Height, top of rail to the top of roof carlines	12 ft. 6 1/16 in.
Height, top of rail to the top of running board over cupola	14 ft. 8 in.
Height, top of rail to the top of floor	3 ft. 11 3/16 in.
Height, maximum, top of rail to center of coupler	2 ft. 10 1/2 in.
Height from underside of the side sill to the top of side plate	7 ft. 6 1/4 in.
Width, inside of car	8 ft. 8 1/16 in.
Height, inside of car (at center)	8 ft. 3 5/16 in.
Width of door opening, one each side	3 ft. 6 in.
Width of end door opening	2 ft. 5 in.
Length of center sill	44 ft. 9 3/4 in.
Thickness of bottom cover plate	0 ft. 1/2 in.
Size of belt rail	5 ft. by 1/4 in.
Size of side plate angle	5 in. by 3 in. by 5/16 in.
Thickness of sheathing above the belt rail.....Angle	0 ft. 7/16 in.
Thickness of sheathing plate below the belt rail..Angle	0 ft. 7/16 in.

taneously from the ground on either side of the car or from a filling opening in the roof. The tank on the range side of the car is used for hot water which is heated in pipes passed through the range. Additional heating facilities are also provided by the use of a steam jacket which surrounds two of the radiator pipes on the range side of the car. The sink basins and shower are provided with supply pipes for hot and cold water.

Every possible short cut for saving time and labor in the final computations has been incorporated in the design and operation of the car. A special method has been provided for integrating the area under the draw bar pull curve. Special devices designed to protect the delicate instruments from unnecessary vibration and shock have been provided. When the liquid in the dynamometer cylinder becomes dangerously low, an electric contact is made automatically, which rings a warning bell. The entire design of the machine is dependent throughout on line contact and is, therefore, quite free from friction. The piston movement for the maximum draw bar pull is .006 inch. Every provision possible has been made to eliminate the effect of friction and the weights of the various parts have been reduced as much as possible in order to decrease the effect of inertia. In order to facilitate the work of compiling data the speedometer is geared so that the height of the speed curve taken in passenger traffic is double for that taken in low speed freight traffic.

The principal feature of the car is the large number of records and miscellaneous information which can be taken, relating to successful train operation. This information can be so arranged that it will not only be of value to the Motive Power Department, but to the various other departments as well.

Locomotive feedwater heating*

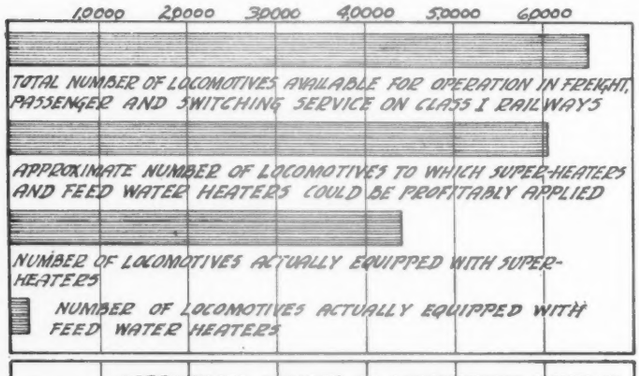
Proper methods of testing important—Building up feedwater temperature and boiler pressure by direct steaming at terminals

By L. G. Plant

Assistant to president, National Boiler Washing Company, Chicago

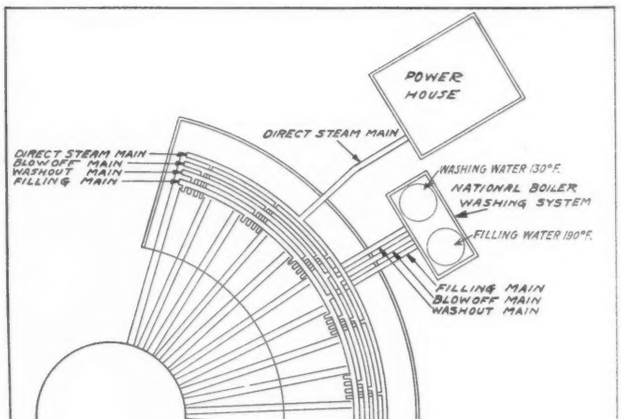
RECENT developments in feedwater heating represent the most fundamental improvement to locomotive economy since the advent of superheating. The application to railway motive power of a long established practice for feedwater heating in stationary power plants is only another belated response to the same economic cause that led to the introduction of superheated steam and other revolutionary changes in locomotive practice.

Each of the several types of feedwater heaters


10000
20000
30000
40000
50000
60000
TOTAL NUMBER OF LOCOMOTIVES AVAILABLE FOR OPERATION IN FREIGHT, PASSENGER AND SWITCHING SERVICE ON CLASS I RAILWAYS
APPROXIMATE NUMBER OF LOCOMOTIVES TO WHICH SUPERHEATERS AND FEED WATER HEATERS COULD BE PROFITABLY APPLIED
NUMBER OF LOCOMOTIVES ACTUALLY EQUIPPED WITH SUPERHEATERS
NUMBER OF LOCOMOTIVES ACTUALLY EQUIPPED WITH FEED WATER HEATERS
APPROXIMATE NUMBER OF LOCOMOTIVES HANDLED AT TERMINALS EQUIPPED TO RECLAIM BLOWN-OFF STEAM FOR HEATING FILLING WATER
10000
20000
30000
40000
50000
60000

Proportion of locomotives equipped with superheaters and feedwater heaters

afford so practical a means for applying to locomotive operation a practice that has long been regarded essential in every efficient stationary power plant that it is difficult to understand why the application of this equipment has been so retarded. Aside from the inertia that accompanies every departure from accustomed practice, there are certain features in the application, operation and maintenance of live steam injectors that exert a strong hold on locomotive practice, so admirable



Plan of enginehouse designed to provide direct injection of live steam and hot filling water into the locomotive boilers

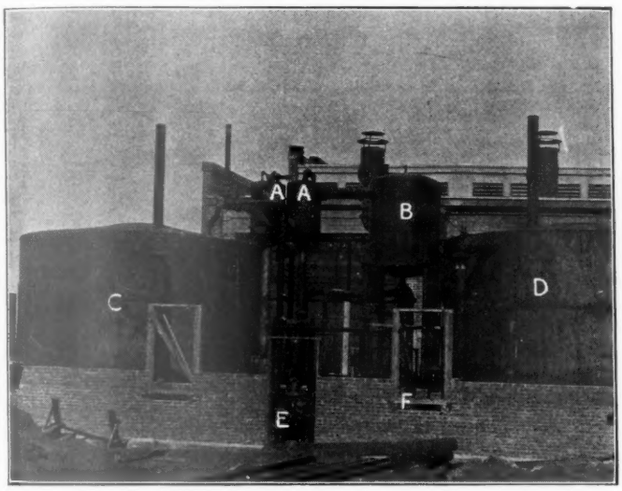
is this device adapted to its requirements. From the standpoint of reliability in service, simplicity in operation and ease of maintenance, there is no locomotive water feeding device comparable with the live steam injector.

Testing methods can be improved

Another factor that has retarded the development of locomotive feedwater heating is the lax and indecisive testing methods to which the application of this equip-

*Abstract of an address at the February meeting of the Central Railway Club, Buffalo, N. Y.

ment is frequently subject. The speaker recalls that about ten years ago he had occasion to investigate the performance of a Caille-Potonie feedwater heater that had been tested on a southeastern railroad some years prior. This is a closed type of heater which was developed in France many years ago and is now extensively used in that country. One of the directors of the American railroad had become interested in the possibilities of such equipment and a heater of this type together with the pump and accessory apparatus had been imported for test on the railroads in this country. The only record of this test disclosed in the files was a report to the superintendent of motive power to the effect that the



A-A—Twin condensers; B—Separator; C—Washout tank; D—Filling tank; E—Washout pump; F—Filling pump.

Boiler washing and filling system in the process of erection

road foreman had made two round trips on the locomotive and had not noticed any improvement in performance due to the application of the feedwater heater. As a result of this exhaustive test the apparatus was dismounted from the locomotive without further investigation and shipped back to France. "Tests" of this general character have cost American railroads a good many millions of dollars.

It is significant that railroads on which the most exhaustive tests of locomotive feedwater heaters have been made are now becoming the most extensive and consistent users of this equipment. There is no lack of authentic data on the performance of locomotive feedwater heaters available to any railroad that is not in a position to make exhaustive tests of this device. In fact, the technical aspects of locomotive feedwater heating are no longer problematical. Tests to determine the practicability and value of this practice are as out of date as similar tests of the superheater. On matters other than maintenance, the relative efficiency of types and improvements to existing equipment, etc., sufficient data is already available and the question of applying feedwater heaters is entirely an economic problem.

Where tests are made, it is particularly important in the case of the locomotive feedwater heater to concentrate attention upon those factors that are strictly relative to the actual value or relative merits of this equipment. Otherwise, the real issues involved may be obscured by a mass of irrelevant data and over-all generalities. The first consideration is that of temperatures attained by water in relation to the temperature of exhaust steam available for heating. Next comes the cost of maintaining this equipment with particular reference to the facilities available for this purpose.

The most important operating characteristic of a locomotive feedwater heater is the temperature at which it can deliver feedwater to the boiler. The economy from feedwater heating increases with each degree rise in temperature of the water delivered to the boiler. Under the conditions usually assumed for locomotive operation, every 12½-degree increase in feedwater temperature accomplished by waste heat represents an increase of one per cent in the steaming capacity of the locomotive. [Mr. Plant here showed curves representing a record of both the feedwater and exhaust steam temperatures observed at different rates of evaporation in the Pennsylvania tests of a decapod type locomotive equipped with an open-type feedwater heater.—Editor.]

The gain in locomotive efficiency by feedwater heating can be determined from these temperatures after the heat content in steam used by the pump has been deducted and the effect of any reduction in back pressure on account of exhaust steam diverted to the feedwater heater has been credited to its performance. No tests of this equipment are complete without a complete record of exhaust steam and feedwater temperatures, a measure of the steam used by the pump and a determination of the back pressure at given cut-offs with and without the feedwater heater in operation.

A partial record of the feedwater and exhaust steam temperatures in the test of a Canadian National Mikado

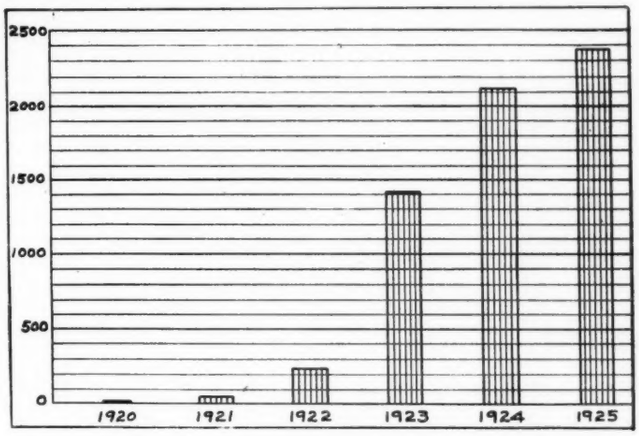


Chart showing yearly growth in the number of heaters in service

type freight locomotive equipped with a closed-type feedwater heater is illustrated.

Feedwater heating at terminals

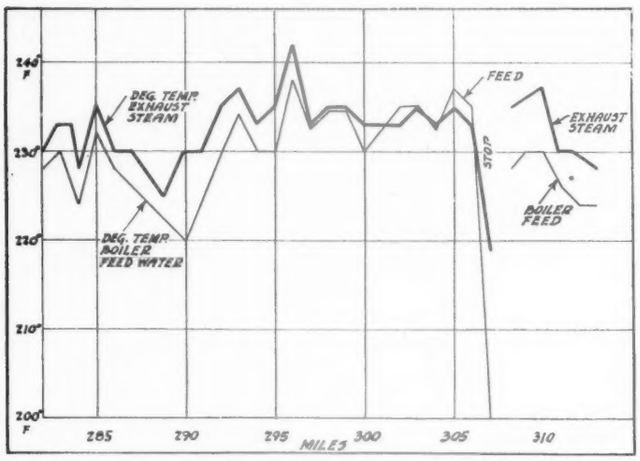
A consideration of the situation at all important locomotive terminals will further enlarge our conception of the realities and possibilities of locomotive feedwater heating. It is estimated that approximately 20 per cent of all locomotive fuel is consumed at terminals. A considerable part of this fuel is consumed in firing up locomotives and the amount required for this purpose depends upon the temperature of the water with which the locomotive boiler is filled. The law requires all boilers to be emptied and washed at least once each month and on many railroads operating conditions necessitate refilling boilers much more frequently. Equipment for washing and filling locomotive boilers with hot water has been generally regarded as merely a convenient maintenance facility.

With the emphasis that is being placed on the economy of feedwater heating on the road, it is only appropriate to direct attention to the fact that it requires about 1,200 lb. less coal to fire up a modern locomotive filled with water

at a temperature of 180 deg. than when the locomotive boiler has been filled with cold water. If the heat required to elevate the filling water to this temperature is reclaimed from the heat content of steam blown off from incoming locomotives, this reduction of 1,200 lb. coal in the quantity of fuel required to fire up the locomotive represents a true saving. One of the illustrations shows the equipment required to obtain this economy, indicating the separator into which the blown-off water and steam from incoming locomotives is first discharged. The water gravitates to the washout tank from which it is drawn for boiler washing purposes. The exhaust steam flows to twin condensers of the jet type, and here again we have an application of the principle involved in the operation of the open-type feedwater heater. Fresh, cold filling water flows to the reservoir from which it is drawn for filling locomotive boilers at temperatures ranging from 180 to 210 deg. Higher delivery temperatures are not practical since the system is operated at atmospheric pressure.

Building up boiler pressure by direct steaming

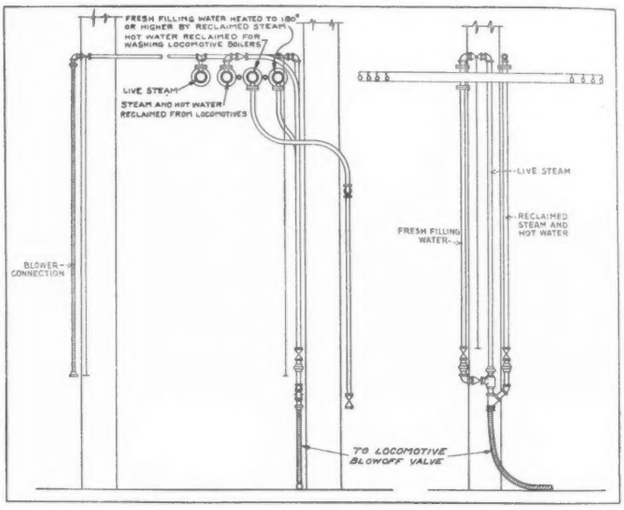
Tests recently conducted on a western railroad develop the fact that for each 20-deg. increase in the temperature at which the locomotive boiler is filled there is a saving of about 8 gal. of oil or its coal equivalent in the quantity of fuel and approximately 10 min. in the time required to fire up a large Mikado type locomotive. These tests, however, are related to a new and even more significant aspect of locomotive feed water heating at terminals. This is the direct injection of live steam and hot filling water by means of the system of mains shown in one of the drawings. The use of live steam drawn direct from a stationary power plant as indicated together with hot filling water, enables a locomotive to be filled and steamed



Temperature record with Elesco feedwater heater on Canadian National 2-8-2 type locomotive

up to a pressure approximating the stationary boiler pressure without lighting the fire in the locomotive firebox. The time required for this operation is about the same as in the usual procedure, but there is a gain in efficiency due to the elimination of the houseblower which ordinarily consumes steam at the rate of 40 boiler hp. per hour or higher. Furthermore, steam supplied from modern stationary boilers can be more efficiently generated than in a locomotive boiler during the firing up stage so that there is a further gain in efficiency on this account. The elimination of smoke and of blower steam within the enginehouse are factors of no little importance. The operation of smokeless enginehouses in which all locomotives are steamed up by this method can be anticipated. In this case all fires would be dumped before locomotives are placed in the house and the fires are not lighted until the locomotive is placed in a firing-up shed adjacent to the enginehouse.

The enginehouse pipe connections required for this method are illustrated. These provide a live steam drop in connection with the hot filling water main and a blow-off connection. In filling a locomotive both the live steam and filling water valves are opened and the boiler filled through the blow-off valve with this mixture of steam and water. As soon as the water shows in the glass it is shut off and the steam allowed to flow into the boiler until the desired pressure is built up. With this arrangement, it is possible to hold locomotives under a working steam pressure. If the fire is lighted as soon as the water shows in the gage glass, the time required to fill and steam up


FRESH FILLING WATER HEATED TO 180° OR HIGHER BY RECLAIMED STEAM
HOT WATER RECLAIMED FOR WASHING LOCOMOTIVE BOILERS
LIVE STEAM
STEAM AND HOT WATER RECLAIMED FROM LOCOMOTIVES
LIVE STEAM
RECLAIMED STEAM AND HOT WATER
FRESH FILLING WATER
BLOWER CONNECTION
TO LOCOMOTIVE BLOWOFF VALVE

System of drops for direct steaming of locomotives without fire on the grates

modern locomotives to a working steam pressure can be reduced to approximately half an hour.

The largest factor for increasing locomotive output may be anticipated in the form of facilities for increasing the percentage of time that locomotives are available for active service. This will come in the form of better equipment for maintaining motive power and turning it rapidly at terminals. Not to exceed 9,000 locomotives are now being operated through terminals having modern equipment for filling boilers with hot feed water heated by blown-off steam. The installation of this type of feedwater heating equipment at all large locomotive terminals would add the equivalent of approximately 1,700 locomotives to the power available for service.

This enlargement in motive power capacity will be accompanied by a reduction in fuel consumption of corresponding proportions so that the outlook for locomotive feed water heating is truly a great prospect.

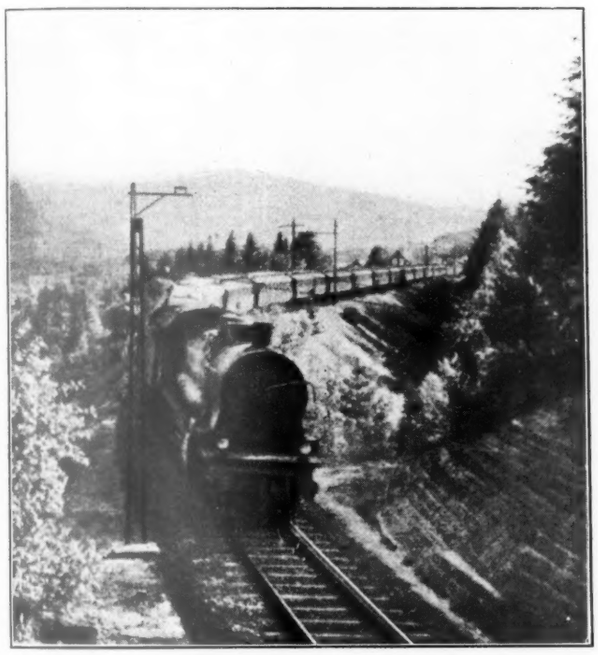
A NEW MOTOR CAR and trailer, built by the Sykes Company, St. Louis, and the St. Louis Car Company, St. Louis, Mo., has recently been delivered to the Boston & Maine. It is planned to place this train in operation between North Adams, Mass., and Troy, N. Y., about March 15. The motor car is 51 ft. over all, comprising a 16-ft. baggage compartment and accommodations for 30 passengers. It is equipped with a Sterling, six-cylinder heavy duty gasoline engine developing 225 hp. The trailer is of the vestibule type and is 45 ft. 6 in. over all and has a seating capacity of 52 persons, making a total of 82 passengers for the train. This is the third motor car unit to be placed in operation on the Boston & Maine.

German State Railway's brake tests

Comparative tests are made with the Westinghouse and Kunze-Knorr types in order to obtain shorter braking distances

LONDON, Eng.

THE first of a series of train brake tests conducted by the German State Railways were inaugurated in March, 1924, and were carried through the year until the latter part of September, when a test train of 23 vestibule coaches was made up and run on September 27, 1924, in connection with the Engineers' Meeting at



Test train used for the trial runs made during the Berlin Railway Exhibition

the Berlin Railway Exposition. The object of the experiments was to determine the efficiency of the Kunze-Knorr brake on express, passenger, freight and mixed trains. It was at first desired only to determine as to what extent the weight and speed of express trains could be safely increased, but while these trials were still in progress, the increase in freight traffic created a demand for an air brake suitable for freight service.

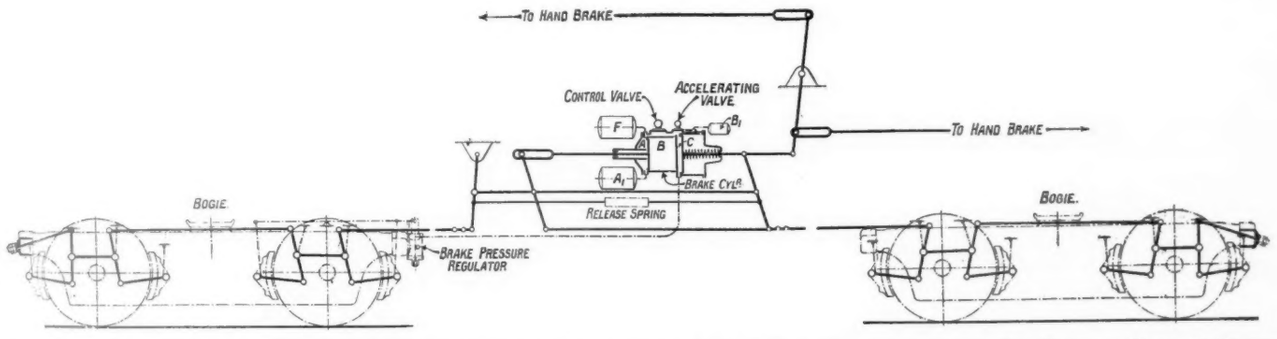
Operating conditions also called for a brake that could stop trains in shorter distances than previously required so that increased speeds would be possible. The distance between the warning signal and home signal on the main line averages about 2,297 ft. The speed, therefore, depends to a large extent on the ability of the engineman to bring the train to a stop within that distance. The engineers who conducted the tests reported that it was possible to bring the average express train to a stop within this distance with the Kunze-Knorr apparatus from an initial speed of 74.5 miles an hour, as compared with an initial speed of 65.25 miles per hour with the type of Westinghouse quick-action brake used in Germany.

A profile of the section over which the trials were made is shown in one of the drawings. The dimensions shown are in the metric system. As will be noted, a number of sharp grades are encountered between Wannsee, a station near Berlin, and Belzig which made this section of track ideal for conducting brake tests. All of the grades, however, were negotiated with the original power until the trains reached Baitz. Pusher service was furnished at this point to take the train up a 2.03 per cent grade to Belzig, which is the ruling grade for the section over which the tests were run.

Results of the second test in which Westinghouse brakes were used

Out of the total of seven trial runs reported, the second run was the only one in which the Westinghouse brakes were used, and even in that test, they were not used exclusively but were in a train which also contained Kunze-Knorr express, passenger and freight type brakes.

The train used in the second run consisted of a ten-wheel type locomotive and 17 cars, which had a total of 52 axles. Of this number 47 axles, or 90 per cent of the total, were braked. Of the 17 cars composing the train, three passenger cars, having two four-wheel trucks, were equipped with the Kunze-Knorr express brake; three four-wheel passenger cars had the Kunze-Knorr passenger brake; four six-wheel passenger cars and three passenger cars having two four-wheel trucks, were equipped with the Westinghouse quick-acting brake; and three four-wheel box cars were equipped with the Kunze-Knorr freight brake. A dynamometer car, an interior view of which is shown in one of the illustrations, was attached to the rear end of the train. This location was chosen for all seven trials on account of the fact that shocks due to braking are more severe at the rear end of the train than



Layout of the foundation rigging of the Kunze-Knorr air brake as applied to a passenger car on the German State Railways

at the front. The dynamometer car was equipped with two four-wheel trucks.

The maximum braking power on the three passenger cars equipped with the Kunze-Knorr express brake was 127 per cent of the total car weight at the beginning and 85 per cent at the end of the stop. In the case of the

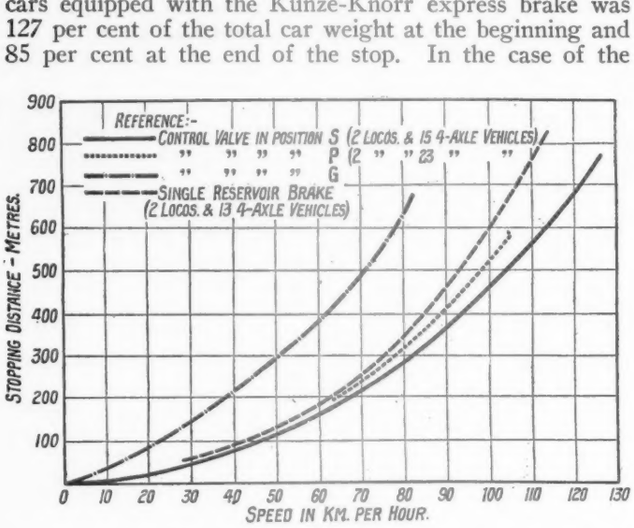

REFERENCE:-
CONTROL VALVE IN POSITION S (2 LOCOS. & 15 4-AXLE VEHICLES)
" " " " P (2 " " 23 " " "
" " " " G
SINGLE RESERVOIR BRAKE
(2 LOCOS. & 13 4-AXLE VEHICLES)
STOPPING DISTANCE - METRES.
SPEED IN KM. PER HOUR.

Chart showing the stopping distances for emergency applications made while running on level track

four-wheel passenger cars equipped with the Kunze-Knorr passenger brake, a maximum braking power of 80 per cent of the total car weight was obtained. The Westinghouse quick-acting brake on the six-wheeled passenger cars recorded a maximum braking power of from 55 per cent to 60 per cent of the total weight of the car. This equipment also recorded a maximum braking power of from 77 per cent to 84 per cent of the total weight on the braked wheels of the three passenger cars, while 75 per cent was the average obtained on the three four-wheel box cars equipped with the Kunze-Knorr freight brake, or 56 per cent of the total weight.

The total weight of the cars in this train amounted to 435 tons. The total weight, including the locomotive, was 536 tons. The maximum brake shoe pressure exerted on the wheels of the train was 442 tons, giving a percentage of brake shoe pressure to the total weight of the train of 83 per cent.

The sixth trial run was the only other test made with mixed equipment. This train, however, had a total of 54 cars with 120 axles hauled by two ten-wheeled type locomotives. Of this number only 75 axles or 62.5 per cent were braked, which does not give sufficient data to make a comparison between the second and sixth tests to ascertain the relative merits of the two brake systems. All of the cars used in the sixth test had Kunze-Knorr brakes. The fifth and seventh test trains were composed entirely of passenger equipment, while the third and fourth test trains were composed of express, and passenger and express equipment, respectively. The first test train,

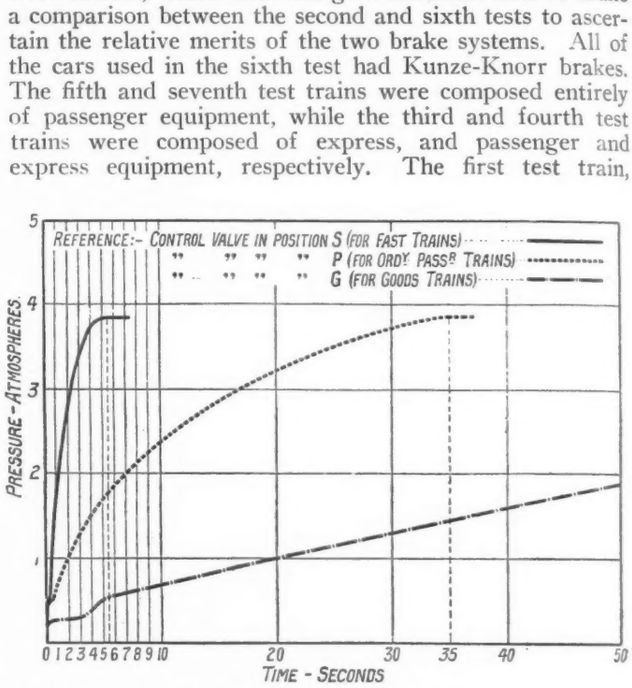

REFERENCE:- CONTROL VALVE IN POSITION S (FOR FAST TRAINS)
" " " " P (FOR ORDY. PASSR. TRAINS)
" " " " G (FOR GOODS TRAINS)
PRESSURE - ATMOSPHERES.
TIME - SECONDS

Chart showing the increase in pressure (in atmospheres) for different positions of the Kunze-Knorr control valve

which was run March 11, 1924, consisted of freight equipment.

Referring to the statement made in a preceding paragraph, in which is given the initial speeds from which a train can be stopped in 2,297 ft., the average braking power required for the Kunze-Knorr brake between the wheel and the rail must, therefore, be approximately

$$\frac{65.25^2}{74.5^2} = 1.3 \text{ times as great as that of the Westinghouse}$$

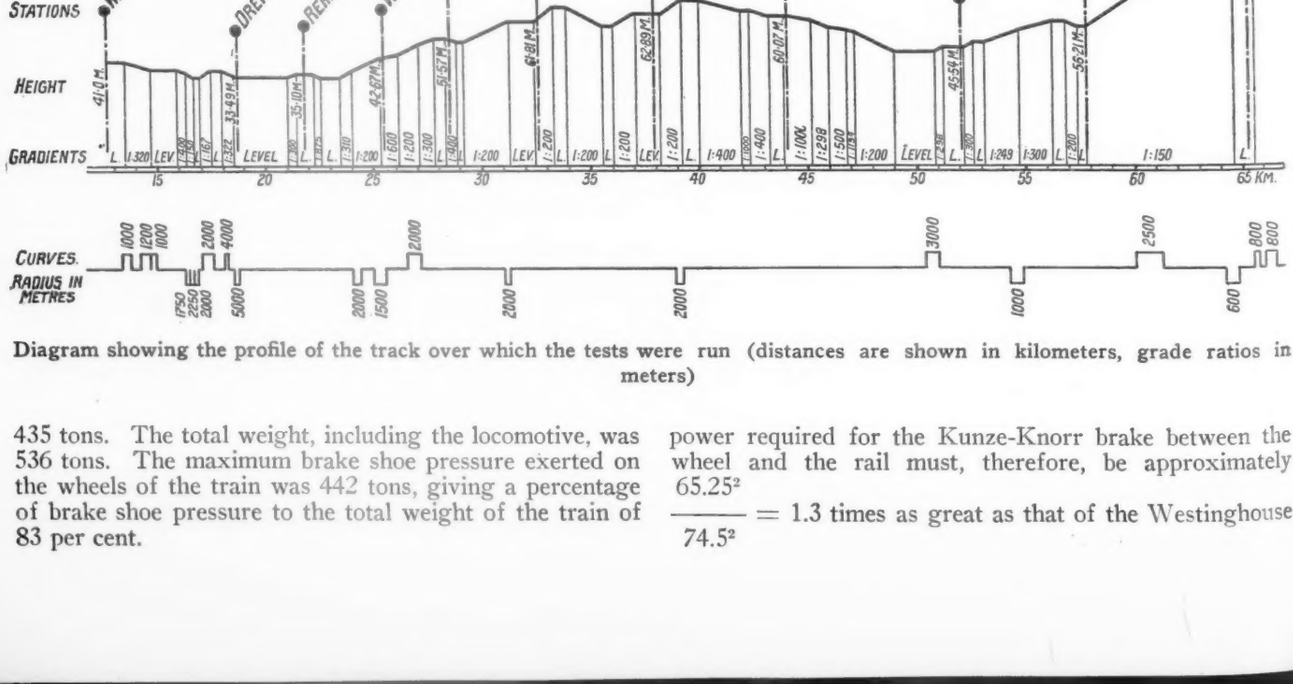


Diagram showing the profile of the track over which the tests were run (distances are shown in kilometers, grade ratios in meters)

brakes, which are at present used on the German State Railways. During the seventh test, a description of which was published in the October 24, 1924, issue of *The Railway Gazette,* London, Eng., the brake shoes of one of the cars, which weighed about 41 tons, were pressed against the wheels with an approximate pressure of 1.3 times the weight of the car, making a total pressure of about 54 tons. While the speed decreases, the coefficient between the brake shoes and the wheels increases and this pressure must be reduced towards the end of the braking distance or the wheels will skid. This factor has been taken into consideration in the design of the Kunze-Knorr brakes, skidding being prevented by

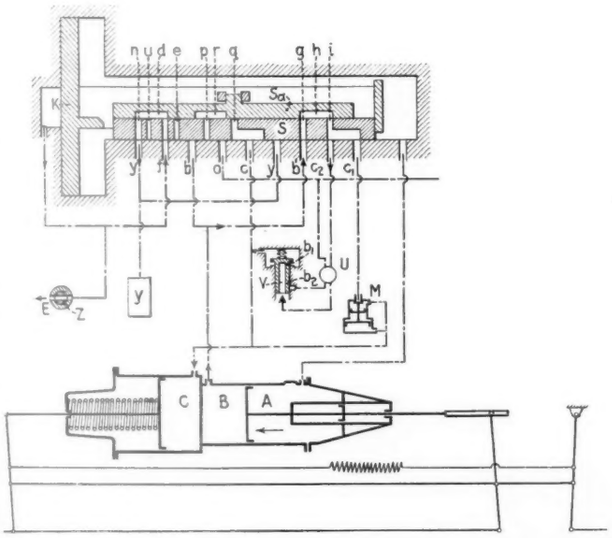


Fig. 1—Diagram showing the arrangement of the Kunze-Knorr brake for freight trains—Triple valve in service position

a pressure regulator *M,* referring to Fig. 1, which is a part of the equipment on each car. This regulator, as soon as the braking power exceeds the given maximum, allows the air to escape from a single-chamber brake cylinder.

The Kunze-Knorr brake

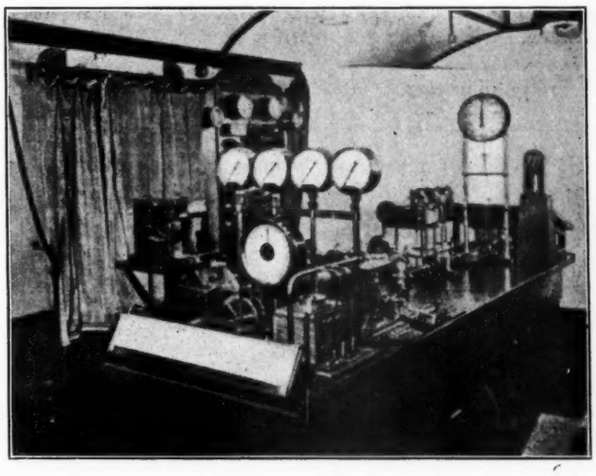
As described by the manufacturers, the Kunze-Knorr brake is an automatic air brake which embodies all the features of the Westinghouse brake in use in Germany combined with a differential brake cylinder which, it is claimed, affords flexibility in braking and a high degree of safety. The designers of the Kunze-Knorr brake have combined the semi-automatic brake, or one-chamber system, with the differential brake, or two-chamber system, which permits graduating the release of the brake.

Referring to Fig. 1, quick propagation of the braking effect throughout the length of a freight train in order to obtain smooth stops is obtained by the propagation pocket *Y,* which is made an integral part of the triple valve body. The restricted size of this pocket limits the brake-cylinder pressure at the first service application by taking up the amount of air pushed forward into the brake valve *K* by the triple valve piston. The direction of air travel from *K* to the propagation pocket *Y* is shown by the arrows. As the triple valve piston moves forward, the ports *y* and *f* are uncovered by the ports *n* and *d,* which permits a direct passage from *K* to *Y*. As the triple valve piston moves forward, it accelerates the action of the compressed air in the brake pipe *E,* which induces increasing pressure and the train comes to a stop. *Z,* which is shown located in the brake pipe, is the isolating cock.

In order to eliminate the shock and dangerous stresses occurring in the handling of long freight trains, the pressure control valve *M* has been inserted in one of the two air passages between the triple valve and the brake cylinder *C*. When the brake is being applied at first, compressed air from the chamber *B* is passing into the brake cylinder *C* through the throttled port *c2* and the larger port *c1,* which leads through the pressure control valve *M*. But as soon as a pressure of about 10 lb. has been reached, the double piston in the pressure control valve *M* closes so that any further rise of brake cylinder pressure is comparatively slow, depending on the amount that the port *c2* is throttled.

The double or differential piston cannot exert any braking effect as long as the same air pressure is acting upon either side of the piston. The control valve *V* being located in the passage between the triple valve slide valve *S* and the brake cylinder the connection between the two chambers *B* and *C* is intercepted as soon as the pressures have equalized so that the spring on top of the valve *V* forces the valve down on its seat. Any further reduction in brake pipe pressure connects the chamber *B* with the atmosphere by the uncovering of the ports *b* and *o* by *p* and *q,* so that this chamber is vented and the full pressure in chamber *A* is acting upon the differential cylinder which increases the braking power accordingly. This additional braking force is used in the Kunze-Knorr system to provide the necessary braking power for loaded cars. Thus, the same approximate braking ratio is available for empty and loaded cars.

The passenger and express equipments are each



Interior view of the dynomometer car, showing the recording apparatus

provided with an accelerating valve designed to increase the speed of the propagation in order to obtain a smooth stop in a short distance from relatively high speeds. The three designs of the Kunze-Knorr brake apparatus are essentially the same. The apparatus may be made applicable to the three different types of service by moving the handle of the change-over cock *V* to one of three positions.

It may be of interest to call attention to the type of draft gear with which the coaches used in the trial runs were equipped. The friction buffers, similar in general appearance to the European style of equipment, applied to these cars were what is known as the "Uerdingen" type which is designed primarily to absorb heavy shocks. It is of the friction type which releases slowly after being compressed.

A dynamometer car was used in all of the trial runs,

the tests comprised emergency and ordinary service stops from both high and low speeds. Records of the speed in kilometers per hour were taken at different points where the train made a test stop, or reduced speed. A profile map of the section over which the trial runs were made, was mounted in the dynamometer car below the speedometers in such a position, as to make it comparatively easy to verify the speeds at a glance on up and down grades and on the level. Both telephone and electrical communication were established between the locomotive and dynamometer car. In order to determine the figures of retardation, a meter of new design was used which directly recorded the retardation figures during braking in meters per sec^2. The speedometers were also driven from the same measuring axle as that of the brake distance meter. The temperature of the brake shoes was measured by a pyrometer connected to thermo-elements screwed into the brake shoes.

Various service applications were made during the tests with the idea of duplicating as closely as possible the ordinary conditions of passenger train operation over the same section of track. A number of emergency applications were made from the dynamometer car. The engineman being entirely unaware of the moment at which the emergency application was to be made. A number of service applications were also made from various speeds.

Eight-wheel switchers for the D. T. & I.

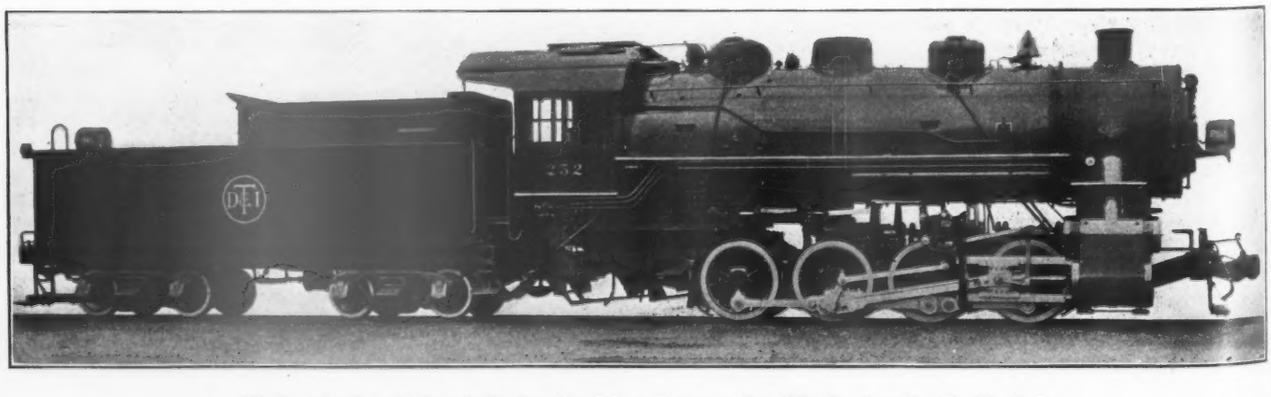
Six of this type recently delivered to Ford's railroad by the Lima Locomotive Works

THE Detroit, Toledo & Ironton has recently received six 0-8-0 switching locomotives which were built by the Lima Locomotive Works. They have a total weight, in working order, of 219,000 lb. for the engine and 155,000 lb. for the tender. The tractive force is 51,200 lb.; factor of adhesion, 4.28; cylinders, 25 in. bore by 28 in. stroke, and the driving wheels are 51 in. in diameter. The height to the top of the stack is 15 ft. and the width over cab footboards, 10 ft. 2 in. The locomotives are designed for maximum grades of 2 per cent and for a maximum curvature of 19 deg.

The boiler is of the straight-top type, radially stayed,

Table of dimensions, weights and proportions

Builder	Lima Locomotive Works
Railroad	Detroit, Toledo & Ironton
Type of locomotive	0-8-0
Service	Switching
Track gage	4 ft. 8½ in.
Cylinders, diameter and stroke	25 in. by 28 in.
Valve gear, type	Baker-Pilliod
Valves	Piston type, size 14 in.
Maximum travel	6¾ in.
Outside lap	1 in.
Exhaust clearance	line and line
Lead in full gear	⅛ in.
Weights in working order:	
On drivers	219,000 lb.
Total engine	219,000 lb.
Tender	155,000 lb.
Wheel bases:	
Driving	15 ft. 0 in.
Total engine and tender	53 ft. ½ in.
Wheels, diameter outside tires:	
Driving	51 in.
Journals, diameter and length:	
Driving, main	10 in. by 12 in.
Driving, others	9 in. by 12 in.
Boiler:	
Type	Straight top
Steam pressure	175 lb.
Fuel, kind	Bituminous
Firebox, length and width	102⅛ in. by 66¼ in.
Tubes, number and diameter	230—2 in.
Flues, number and diameter	36—5½ in.
Length over tube sheets	15 ft.
Grate area	47 sq. ft.
Heating surfaces:	
Firebox and arch tube	208 sq. ft.
Tubes and flues	2,569 sq. ft.
Total evaporative	2,777 sq. ft.
Superheating	610 sq. ft.
Comb. evaporative and superheating	3,387 sq. ft.
Tender:	
Style	U-shaped
Water capacity	8,200 gal.
Fuel capacity	11 tons
General data estimated:	
Rated tractive force, 85 per cent	51,200 lb.
Weight proportions:	
Weight on drivers ÷ tractive force	4.28
Total weight engine ÷ comb. heat. surface	64.6
Boiler proportions:	
Tractive force ÷ comb. heat. surface	15.1
Tractive force x dia. drivers ÷ comb. heat. surface	77.1
Firebox heat. surface ÷ grate area	4.4
Firebox heat. surface, per cent of evap. heat. surface	7.5
Superheat. surface, per cent of evap. heat. surface	22.0



Eight-wheel switcher built by the Lima Locomotive Works for the D. T. & I.

without combustion chamber, and with two circular courses 80 in. and 81-7/16 in. outside diameter. The working pressure is 175 lb. per sq. in. The boilers are equipped with Type A double loop, 36-element superheaters. There are 230 tubes, 2 in. in diameter and 36 superheater flues 5½ in. in diameter; the length over the tube sheets is 15 ft. The firebox is 66¼ in. wide and 102⅛ in. long with grates of the rocking bar type and a grate area of 47 sq. ft. The ash pans are of the center-hopper type. Hancock No. 11 Type A lifting injectors supply the feedwater. The total evaporative heating surface is 2,777 sq. ft. and the superheating surface, 610 sq. ft. Consolidated safety valves are used.

Steam distribution is effected by means of Baker-Pilliod valve gear, the diameter of the piston valves being 14 in. The valves are set with a travel of 6¾ in., 1-in. lap, ⅛-in. lead and line and line for the exhaust. A Lewis power reverse gear is applied. The air brake equipment was furnished by the New York Air Brake Company, and includes one 8½-in. cross-compound pump and two 18½-in. by 120-in. air reservoirs. The headlight equipment is Sunbeam with lights on both the front of the engine and the rear of the tender. The piston and valve rod packing is U. S. King type metallic. The Franklin unit drawbar and radial buffer are used between engine and tender. The material for axles and piston rods is alloy steel after Lima specifications, while that used for the side and main rods and crank pins is after specifications furnished by the Ford Motor Company. Brass shoes and mild steel wedges are used in connection with the usual type of cast steel driving boxes.

The tender is of the U-shaped level top tank type with a water capacity of 8,200 gal. and coal space for 11 tons. Bituminous coal is used. The tender tank is supported on a Comsco cast steel tender frame and four-wheel tender trucks which have cast steel truck side frames, elliptic springs and steel wheels. The important dimensions and proportions are given in the table.

Increasing income by reducing repair costs

By H. Y. Carpenter
Mechanical engineer, Davenport Locomotive Works, Davenport, Iowa.

A NUMBER of articles have appeared in recent issues of the *Railway Mechanical Engineer* in which comments have been made relative to the difficulties encountered in the making of certain locomotive repairs, due to faulty design. Many specific items were brought out, which, if corrected in the design of locomotives to be ordered in the future, would facilitate the work of maintenance and shorten the amount of time and labor required to do the work.

The biggest problem of the mechanical department is to keep its locomotives and cars on the road and to minimize the time they are held out of service for repairs. Men engaged in locomotive repair work can see practically every day many changes which could be made that would reduce the work of making certain repairs in both the back shop and enginehouse, and in some instances the repairs could undoubtedly be avoided altogether. The attention of the proper officers is often directed to certain difficulties encountered in the repair of a certain class of power, yet new locomotives are ordered having the same faults as those against which complaints have been made. Locomotives held out of service for any reason are actually draining the profits of those that are on the road and everything possible should be done to keep the equipment in service and out of the shop.

All too frequently such conditions are due to the manner in which the road purchases its locomotives. It reflects no discredit on the builders. Take, for example, a road that has never had any Mikado type locomotives and decides to place an order for a number of this type. Specifications are generally started about the time the operating department has begun to feel the pinch for additional power, and it is a matter of great importance that the earliest possible delivery be obtained. Specifications stating the size and type of engine, wheel loads, and various dimensions that appear to be about right for the conditions to be met, are sent to the builders together with a number of prints of a few parts which are fairly standard on the road. From this data, the builder must design and construct a locomotive and deliver the same in the shortest possible time. He adheres to the information given him and delivers a locomotive that is economical and satisfactory from an operating point of view, but when these engines begin to require extensive repairs, it is found that they do not fit in with the other power on the road, resulting in an increased stock for the stores department to carry. An increase in stock at one point is bad enough, but usually the locomotives are distributed over the system which makes it necessary for the stores department to carry increased stocks at many points to avoid delays by having to wait for deliveries from the general stores.

Co-operation with the builders is essential to standardization

In a case like this the builder's main concern is to build a locomotive to meet the specifications and blue prints furnished him and to meet the delivery date. With that he has his hands full. He has no time to investigate local conditions to see whether or not he can use rod brasses which would be common to some other type on the road and thereby keep down the number to be carried in stock. If he can use parts that are duplicates of what he has already made for some other road, it is to his advantage to do so, and so long as such a procedure does not conflict with the specifications and information furnished him, it is entirely legitimate to do so. But the point is that new parts are brought into existence which are not quite similar in design to others used on that road. The builder could have perhaps just as easily furnished parts that would have been common to one or more existing classes had he known what these were, but in cases of rush orders, he does not know nor does he have time to investigate. If only one part on a locomotive order for a single type was involved, the result would be negligible, but the chances are that it is many parts.

Take for example, a road that already has had one order of Mikado type locomotives and orders more from the same builder. Unless there is a great difference in the size of the locomotives on the two orders, a large number of the parts will be interchangeable. If a set of drawings accompanies the second order, the chances are that these drawings will be exact duplicates of those which the builder furnished with the first order. Unless these drawings have been revised to remove the objectionable features the second lot of locomotives will have as many objectionable features from the shop point of view as its predecessors.

Here is where closer co-operation between the shop and the office becomes noticeably desirable. If every man who had encountered any difficulty in the repair or operation of these locomotives submitted an account of his difficulties together with a proposed remedy, the mechanical engineering department could immediately incorporate

such suggestions into the design of the locomotives on the second order, if possible, and a decidedly better locomotive than those on the first order would result. To be sure, some criticisms do come in, but not all that should do so. A shop superintendent or a master mechanic may report some objection he has noticed, but the erecting gang foreman and the enginehouse foreman are seldom heard from. These men are the ones who find the small things, such as the side from which a pin should be put in, the application of which has required a disproportionate amount of time for repair.

The importance of following standard practice

There are unquestionably many parts that could be reduced from nearly as many varieties as there have been orders for locomotives to a few parts that would be standard to practically all classes. Among these are rod brasses, crank pins, driving and truck boxes, valve motion pins and bushings, crosshead pins, etc. For example, in the case of rod brasses, when a locomotive came into the shop which required new ones and those it had were not of standard design, more time than is usual would be required in applying it. But the next and each succeeding time the locomotive came in for repairs the time required to renew the brasses would be reduced to a minimum and there would be more of a possibility of the brass being in stock. It was found by one railroad that by redesigning its car trucks to be equipped with cast steel side frames, it could use one entirely new bolster and one new side frame on five different classes of 50-ton cars which had previously required as many different styles of side frames and bolsters.

Another fault to be found with many railroads has been the policy of purchasing a new type of locomotive before its adaptability to the operating conditions on the road has been fully determined. A case is known of one road which once purchased a number of Mallets only to find them unsuited to its operating conditions. The locomotives were sold to another road a few years later. The policy of the Pennsylvania of getting only one locomotive of a new type which is thoroughly tried out in service before an order for any quantity is placed, certainly has much to commend it. "It is better to have only one lemon than a bagful."

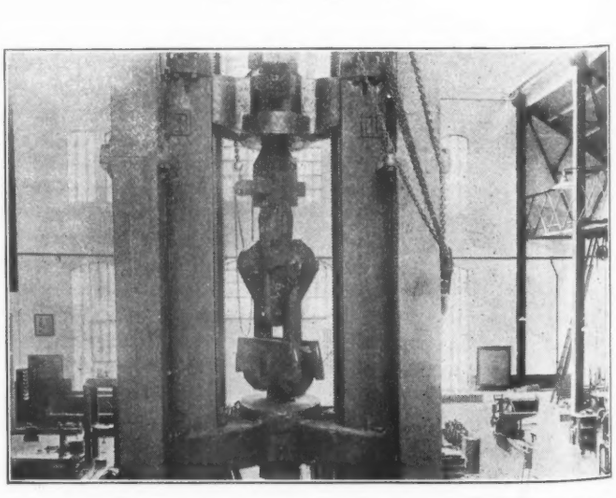
Locomotives should be designed by the mechanical engineering department

In the October number of Baldwin Locomotives, published by the Baldwin Locomotive Works, Philadelphia, Pa., is the third of a series of articles on the "Motive Power Development on the Pennsylvania System." The need of standardization was realized early in the history of the Pennsylvania and its locomotives have been developed one from another in a most logical and creditable manner. While the Pennsylvania has perhaps more locomotives of a single class than many roads possess altogether, what it has done can also be done to good advantage on many of the larger roads, even though they do not attempt to build any locomotives in their own shops.

The most feasible method of accomplishing the best results is for the mechanical engineering department of the railroad to design its own equipment, to fit the local conditions, which no builder can be expected to know sufficiently well to serve to the best advantage. By that, general design is not implied, but detail design; design that covers every part, so that when an order is placed a complete set of drawings accompany the specifications. The builder can then construct a locomotive which will fit in with the other equipment on the road. Sufficient inspectors should be provided to see that there is no deviation from the specifications, for even as small a matter as threads may cause considerable aggravation and delay in repairs. If such a course were adopted it should certainly lead to a considerable saving in maintenance. It would insure interchangeability of parts and would also result in getting locomotives which would come nearer to suiting local operating conditions.

This, however, cannot be done with the force usually allowed the mechanical engineer on many roads. As a rule, his department is only sufficient to handle the usual routine work. It should be large enough, however, to anticipate the needs of the future by preparing designs in advance. His office should receive reports of all engine failures, and be a clearing house for criticisms and suggestions relative to the road's equipment from the lowest man in the organization to the president. With a large amount of such data on file, with more arriving every day, each new design should be a distinct improvement over its predecessors. It is evident that the staff of the mechanical engineer should be adequate both in numbers and ability to carry the load that is thus imposed. While this department should be in close touch with the shop, it should not be relegated to unsuitable quarters, as the case on one large road, the mechanical engineering department of which is located just across the turntable pit from the enginehouse.

Many light repairs can be made without bringing locomotives into the enginehouse. This not only eliminates the delay incident to the two movements in and out of the house, but keeps it out of the way of other locomotives at busy times. It is such repairs as these that often necessitate putting a locomotive inside and making a short job—a long one, on account of the parts being inaccessible or because the part furnished by the builders was not identical with that which the road carried in stock. Such cases can be cured by closer co-operation between the shop and the office, and by providing the mechanical engineer with complete failure reports together with unrestricted and uncensored criticisms, and by performing the complete detail design of future power in the road's own mechanical engineering department. This requires a broad minded policy on the part of the management as well as a sufficient and competent force under a mechanical engineer who is alive to the responsibilities imposed upon him. It will reduce the time required to make repairs, the amount of materials carried in stock and equipment will be in service more of the time.



Coupler yoke being tested for tensile strength at Lehigh University

Precipitation of water in compressed air systems*

By D. W. Lloyd
Assistant to general manager, Westinghouse Air Brake Company, New York

MANY technical articles have been prepared and are available for study, fully covering the laws governing the absorption and precipitation of moisture by air under pressure and temperature changes. Early investigators and scientists determined these laws many years ago. It is not the purpose, however, of this discussion to encroach at all upon this field of technical data but it is hoped that a strictly non-technical explanation concerning the working of these established laws may be of some assistance in obtaining a general understanding concerning them.

Atmospheric air always contains more or less moisture. Probably the most important function of the atmosphere is to convey and distribute moisture over the earth. Below the "dewpoint" or 100 per cent humidity mark, this moisture is in gaseous form, entirely invisible and as "dry" in the ordinarily accepted sense of the word as the air itself. When the saturation point or 100 per cent humidity mark is exceeded the excess water vapor condenses and becomes visible in the form of fog, which is made up of drops of water floating in the air. The atmospheric humidity varies continuously with changes in conditions, and the average humidity varies through wide ranges in different localities. The United States Weather Bureau shows the following mean percentages of humidities at different localities: Galveston, Tex., .85; New York City, .73; Salt Lake City, Utah, .53; Yuma, Ariz., .42; and El Paso, Tex., .39. It is somewhat curious that both the maximum and minimum values are found in Texas.

Effect of temperature and pressure on the moisture carrying capacity of air

The amount of moisture in a given amount of air at 100 per cent humidity depends on the pressure and the temperature. Considering pressure alone, the law states that the vapor carrying capacity varies inversely as the absolute pressure. In other words, if a cubic foot of free air, approximately 15 lb. absolute pressure at 100 per cent humidity is compressed to 60 lbs. gage pressure (75 lb. absolute) or five atmospheres, without change in temperature, it will be able to hold only one-fifth of the original moisture content in suspension and the remaining four-fifths will be precipitated as fog which will ultimately settle to the bottom of the container and form water.

To look at this from another angle, it is apparent that when the one cubic foot of free air is compressed to five atmospheres, its volume is reduced to one-fifth of the original volume. In other words, the space occupied is reduced in the same ratio as the ability to carry moisture in the form of vapor. This means that a given space can accommodate a given amount of water vapor regardless of the pressure of the air in that space, the temperatures remaining the same.

Changes in temperature, however, have a very pronounced effect on the amount of vapor that can be carried in suspension. The following table, which will be found in most hand books, gives the weight of water vapor per cubic foot of space at 100 per cent saturation and for each 1,000 cu. ft. of space at different temperatures:

Weight of water at different temperatures

Temperatures, degrees F.	Lbs. of water per cu. ft.	Lbs. of water per 1,000 cu. ft.
120	.00488	4.88
115	.00425	4.25
110	.00372	3.72
105	.00324	3.24
100	.00282	2.82
90	.00211	2.11
80	.00155	1.55
70	.00114	1.14
50	.000813	.813
50	.000585	.585
40	.000399	.399
30	.000271	.271
20	.000114	.114

This table may seem to be somewhat abstract for purposes of visualizing the actual amount of water that may be held in suspension in the atmosphere at 100 per cent humidity. A pint of water weighs 1.05 lb. so as a convenient point of comparison the reader will note that 1,000 cu. ft. of free air at 100 per cent humidity contains approximately this amount at normal room temperature of 70 deg. F.; in other words, the air in a room 10 ft. square with a 10-ft. ceiling can and does contain as much as a pint of water without causing any feeling of dampness whatever.

The tables will also show that within the normal range of temperatures, the amount of water vapor that can be held in suspension in this way is approximately doubled for each 20 deg. F. increase in temperature. This is only an approximate relation, but it affords a convenient means for easy analysis of the proposition within the limits of ordinary temperatures during compression and expansion.

Effect of increased temperatures

All are familiar with the fact that the temperature of air is increased during compression. We have then both the factors of temperature and pressure changes to consider when analyzing what happens to the moisture contained in the air drawn into the compressor suction, and as it passes from the compressor discharge out into the compressed air system. For example, assume an atmospheric temperature of 60 deg. F. and, for simplicity, a humidity of 100 per cent. This humidity is often obtained and is sometimes exceeded on wet days or where the compressor suction is exposed to drip or steam leaks. Assume also that the compressor is working against 75 lb. main reservoir pressure, which is approximately six atmospheres. The theoretical temperature due to compression is about 420 deg. F. This temperature will not actually be obtained, because of radiation from the cylinder walls. But as a conservative value, we can say that the air will be at least 200 deg. F. when it leaves the compressor discharge and enters the system.

The temerature between the inlet and discharge has therefore been raised at least 140 deg. F., or a total of seven steps of 20 deg. each. Considering that the moisture carrying capacity is doubled for each 20 deg. F. rise, its ability to carry moisture out of the compressor, as a result of the increased temperature, will be $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$, or 128 fold of what it was when it was

*Abstract of a paper read before the Manhattan Air Brake Club, New York, February 20, 1925.

drawn into the suction. Actually, the increased capacity due to this change in temperature is even greater than that obtained by this approximate method of calculation.

Effect of increased pressure

Offsetting this increased thirst of the air because of the heat, we have the effect of the increase in pressure. This effect is, however, only in proportion to the pressure increase which in this assumed case is six atmospheres, or six times the initial pressure. The net effect of the 128-fold increase and the six-fold decrease is the product of the two or more than a 20-fold increase. It will be apparent, therefore, that the air will not begin to deposit any of its moisture until considerable cooling has been effected. Under the assumed conditions, the precipitation will not start until somewhere along in the system where the temperature has dropped somewhat below 120 deg. F. Because at this point the temperature is still 60 deg. F. higher than the atmosphere, or three steps of 20 deg. F. each which produces $2 \times 2 \times 2$, or an eight-fold increase in moisture carrying capacity which still more than offsets the tendency of the increased pressure to reduce its capacity to one-sixth what it was in the beginning.

Five-sixths of the original moisture must be deposited somewhere between this point and the ultimate discharge from the system, assuming that the compressed air is finally cooled to the temperature of the atmosphere.

Collection of moisture in the brake system

The actual amounts of water that are involved in every-day air brake practice may be readily calculated. Even with a good tight train line the air lost from leakage alone in a 100-car train may run as high as 30 cu. ft. per min. If we assume that the average amount of air required for the train is 35 cu. ft. per min., or 2,100 cu. ft. per hour, under warm weather conditions with high humidity, we can see that about ½ gal. of water is being drawn into the compressor suction every hour and all but a small portion of it must be deposited in the main reservoir and elsewhere in the system. Fortunately, under cold weather conditions the atmosphere cannot carry as much moisture as in the summer, otherwise we would have much more trouble due to freezing of this condensation in the piping and the valve devices than is now experienced. The table shows that at freezing temperatures the amount of water is less than one-tenth of what it is at a temperature of 100 deg. F.

The radiating pipe on the locomotive is, of course, designed to provide as much cooling effect as possible on the locomotive so that the moisture may be deposited in the main reservoirs from which it can be drained. A recent survey of main reservoir piping on locomotives on various roads was recently made during which temperatures were taken at certain intervals of time during actual operation at various points in the piping to determine the efficiency of the cooling actually effected. In many cases it was found that the cooling pipe was located, either close to the firebox or in such a location that free circulation of atmospheric air around it was not afforded. This resulted in the air being reheated after leaving the first main reservoir, or possibly the second main reservoir and arriving at the brake valve, feed valve and other operating devices on the locomotive at a higher temperature than when in the reservoirs. This, of course, is a bad condition and increases the possibility of precipitation of moisture, with consequent damaging operating results in the valve devices on the locomotive and even in the train line.

It may be of interest to know the results of an investigation that was carried out by the Westinghouse Air Brake Company several years ago to determine to what extent water or condensation worked its way into the auxiliary reservoirs of freight brake equipment. During this investigation, which was carried out in the summer, more than 2,000 auxiliary reservoirs were examined. Water in varying amounts was found in 200 reservoirs or approximately 10 per cent of the total. The maximum amount in any reservoir was three gallons; another one had two gallons, and about 6 per cent out of the 10 per cent having any water at all had one pint or more. Practically all the dirt collectors on the cars examined either showed water or a rusty condition, indicating that they had held water at some recent time.

The length of radiating pipe

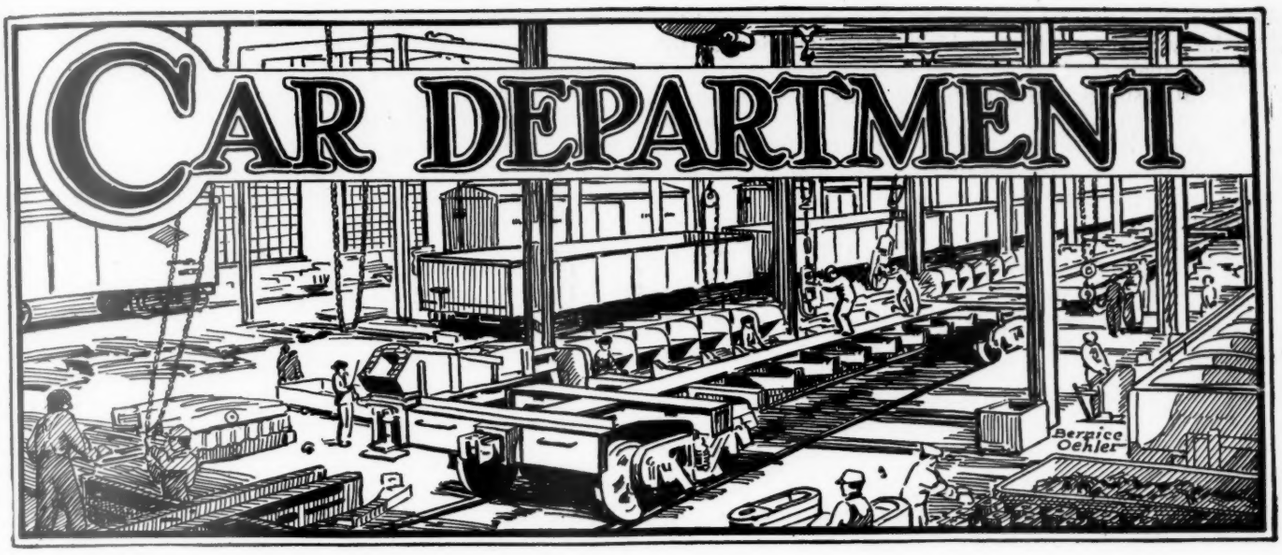
The Westinghouse Air Brake Company's recommendations as to length of radiating pipe for cooling purposes have for many years called for approximately 45 ft. between the compressor and the first main reservoir, and a like amount between the first and second main reservoirs. The Air Brake Association's recommended practice specifies as follows:

> Not less than 25 ft., nor more than 45 ft. of cooling pipe should be used between the air compressor and the first main reservoir. With two air compressors per locomotive, duplicate the amount of discharge pipe specified for one, these pipes to be connected to the main reservoir through a Y-fitting and a short two-inch extra strong nipple.
>
> The equalizing pipe between the main reservoirs should not be less than 1¼ in. in diameter and not less than 25 ft. nor more than 45 ft. long.
>
> The radiating pipe connected to the main reservoir should be located in the coolest possible place and placed so as to drain toward the reservoirs.

These recommendations allow considerable latitude. The reason for this is because it is practically out of the question to make any specific recommendation that will not be objectionable under certain circumstances. The atmospheric conditions in such localities as Florida and the Southwest differ widely from conditions in the Northern part of the country. The folly of attempting to specify an installation that will be equally well adapted to all conditions will be at once apparent. Under warm weather conditions, doubling or even tripling the lengths of pipe specified as a maximum by the Air Brake Association would not be sufficient to cool the air back to atmospheric temperature before reaching the brake valve. But under some extreme cold weather conditions, such an installation would without question permit the air to be cooled to freezing temperatures and below before even reaching the first main reservoir, with the result that the moisture would freeze and stop up the discharge to the main reservoir.

This condition has been obtained in steam road service and is quite a frequent occurrence in traction service. In order to avoid this and secure the desired results at all times would require an adjustable system which could be varied with changes in atmospheric temperatures, which is, of course, out of the question. The compromise to be sought is one that will produce a maximum of cooling with a minimum possibility of freezing.

It has been previously pointed out that the overall effect of compression of the air is to increase the thirst or moisture carrying ability of the air. Consequently, the effect of expansion is to cause a deposit of moisture. The effect produced as the air passes through the feed valve is well known to all air brake men. Drain cups, centrifugal dirt collectors with drain cocks, and reservoirs to catch condensation are commonly placed in the piping adjacent to the feed valve or under the brake valve and periodically drained of moisture collecting at this point.



The prevention of hot boxes*

A systematic record and analysis of the causes will suggest the proper remedy

By T. O. Quinn, Cleveland, Ohio

EPIDEMICS of hot boxes, no doubt, have been experienced by practically all roads handling any great volume of freight business, which has called for a large number of explanatory reports on the part of those in direct charge of car department work, these reports having been furnished generally, after a hurried investigation.

It is the writer's opinion that fully 75 per cent of the trouble caused by hot boxes is the direct result of the failure of the human factor to function properly, either through neglect or carelessness, and in some few cases through lack of proper methods and instructions. In order permanently to correct or eliminate such conditions, a thorough investigation from all angles is necessary before drawing any conclusions as to the principal cause for hot box epidemics, taking into consideration the human element involved and the possibility of the working force neglecting or overlooking some minor detail of the work assigned them. By the time the cause is located the organization is generally working to the entire satisfaction of all concerned, and can only be maintained at that point by the proper supervision of those engaged in hot box prevention work.

My experience leads me to believe that epidemics of hot boxes are caused mainly through improper lubrication and that in about three-fourths of the cases improper lubrication is due to the failure of the human element, and is not generally due to mechanical conditions. To lubricate properly the journals of railway freight equipment, considerable training of forces doing this class of work is required, as the "car knocker" is the principle cog in the machinery that causes, and through whom the cures are effected, where the hot box epidemics are concerned. Therefore the importance of his duty must be shown him in such a manner as to secure his interest in the work he is to do, if corrective measures are to be applied and satisfactory conditions maintained.

Methods to be followed to get the proper lubrications with our present lubricating system should consist of the packing and adjusting of journal box packing in the following manner, providing that the journal packing has been properly saturated with a good grade of car oil: first, in packing or repacking of a journal box complete, there should be inserted in the mouth or front of the journal box, a roll of journal packing, approximately 2½ in. in diameter and 10½ in. in length for journals 8 in. and 9 in. in length, and a roll approximately 3 in. in diameter and 12 in. in length for journals 10 in. and 11 in. in length, the rolls to have the ends square and uniform and to be held in a firm position by being tied with strands of waste or their wrappings, and then worked back under the journal to the extreme back of the box, leaving it in such a position that it does not extend above the center line of the journal. The rest of the packing is then placed firmly under the journal to prevent settling away from it, this being accomplished by placing the packing across the full width of the mouth of journal box, allowing the strands to hang down outside until packing is complete. Additional packing is applied on top of the overhanging strands, which form a binding for the entire mass and prevents the separation of the packing. The journal packing, when completed, should not extend above the center line of the journal at any point, neither should the front of the box be filled with packing, as this prevents proper inspection and does not lubricate the journal.

The attention to journal packing where repacking of

*A paper submitted in the competition on hot box prevention which closed March 1, 1924.

the box is not required, should consist of inspection, and the adjusting and reworking of the packing in the following manner:

Careful inspection should be made by close examination of the journal and contained parts of the journal box and defective mechanical conditions corrected. On a box where no mechanical defects exist and the journal shows any indication of heating, the journal packing should be loosened and pulled forward from the sides and worked back under the journal from the center, in order to break up the glazed surface of the packing from long contact with the journal and to raise the center portion of the packing in the box against the bottom of the journal. Where excessive packing or packing in a dry condition is encountered, it should be removed and in case insufficient packing remains, fresh saturated packing should be inserted and worked under the journal from the front and bottom portion of the box, raising the packing on each side to the center line of the journal.

Hot box epidemics, where they have been due to the lack of proper attention, have been corrected and satisfactory conditions maintained by following closely the above methods.

Sometimes it is difficult to determine the particular employee at fault or the one that is negligent in performing his work and some system is necessary whereby that person can be located and properly instructed. The method outlined below has been worked out and followed with success in a number of cases where hot box epidemics were caused through the failure of one or more men in the organization.

At the larger terminals where a large force of oilers is used, the men are divided into crews or gangs of four. One oiler takes care of the outside boxes on one side of each car in the train, and one oiler takes care of the inside boxes on the same side, the other two oilers handling the opposite side in the same manner, two men working always on the south or east side and the other two men always working on the north or west side. When oiling attention is completed the last man finishing a car on his side applies identification marks with chalk showing the station, symbol and date.

Hot box forms such as illustrated, are made out either by the inspector or the trainman whenever cars are set out or require attention en route. This form when filled out complete, contains all the information required to locate the oiler last giving the box attention at a terminal, prior to the departure of the train. The completed forms are made in duplicate and one copy forwarded to the car foreman at the originating point and one copy to the division car foreman or district master car builder, which enables the supervisors to deal at once with the party responsible, where the cause would indicate that failure was due to lack of attention.

Improper turning or truing of journals, resulting in hot boxes within a short time after application or change of wheels is one of the lesser causes of hot boxes. This arises in a number of cases from the use of a roller for applying the finish to journals. Where a roller has been used it has been found that the fine edges left from cutting or finishing tools are merely rolled into the journal only to be brought out when more than ordinary friction heat is produced, the result is a cut journal before the journal bearings become properly seated. The exact fitting of journal bearings is of minor importance where all other conditions are normal.

Where this condition was found the use of the roller was done away with entirely and journals for both freight and passenger service turned in the usual manner, a finishing cut being taken about 3/64-in. in width, particular attention being paid to see that collars and fillets are turned properly. The journals are then polished with a polishing stick and emery cloth, using No. 2 cloth for the first application and finishing with No. 00 cloth.

On another occasion a small epidemic of hot boxes was caused by car repairmen, in applying or changing wheels, preparing their journal bearings with a thin coating of oil prior to application, then allowing the bearing to remain near the ground while the balance of the work was completed on the car. In some cases the bearing was left in this position for an hour or more, with the natural result that the oil caught and retained all the foreign substances striking it. At the time the epidemic developed the season

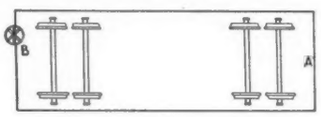
ABC RAILROAD

INSPECTORS AND TRAIN CONDUCTOR'S HOT BOX REPORT

Report only boxes that are smoking hot and require packing or change of brass by reason of running hot

Date_____ Train No._____
Division_____ Station_____
Car Initials_____ No._____ Kind_____

If freight car, show on diagram location of hot box
If passenger car give box number
Show side, North-South-East-West
Show station and date last given oiling attention



Date Boxes Last Repacked

Probable cause of heating indicated by drawing line through cause which applies to the case. If none give cause in remarks		
	1. Lack or Waste	6. Doubtful
	2. Brass Worn Thin	7. Waste Grab
	3. Overloaded	8. Wrong Brass
	4. Brass Worn Unevenly	9. Broken Brass
	5. Journal Rough or Seamy	10. Lining Cracked

Delay to train_____ Hours_____ Minutes
Originating point of shipment_____
Cap'y of car_____ Weight of load_____

Remarks:_____

Inspector or Conductor

This report must be made out promptly and sent to Division Master Car Builder for all hot boxes. Division Master Car Builder to forward one copy to Foreman at originating point.

Sample of the form used for reporting hot boxes

was extremely windy. When located, the matter was readily corrected by the exercise of more care in the handling of the journal bearings.

An increase in hot boxes generally follows a serious reduction in car department forces or when labor troubles are encountered, such as were experienced during 1922, but the result can hardly be called an epidemic. This condition is more generally due to a lack of attention and involves both the human and mechanical conditions.

The mechanical features resulting in the occasional hot box are generally understood and involve such defects as:

1.—Worn journal bearing, resulting in cracked bearings and improper bearing surface.

2.—Bent arch bars and truck out of line, resulting in the weight of the load being equally distributed on the journal bearing.

3.—Slid flat or shelled out wheels, causing the journal packing to settle away from the journal through the jar of the wheel, resulting in lack of lubrication and also distorting the contour of the brass.

4.—Improperly fitting journal wedge, resulting in uneven wear on the bearing.

5.—Missing journal box covers, permitting foreign substances of all kinds to enter the box and prevent proper lubrication of the journal.

By closely following the methods outlined hot box epidemics have been entirely eliminated and car failures per mile from this cause reduced to a minimum, resulting in increasing the mileage on the division where this method has been carried out to 585,113 miles per failure.

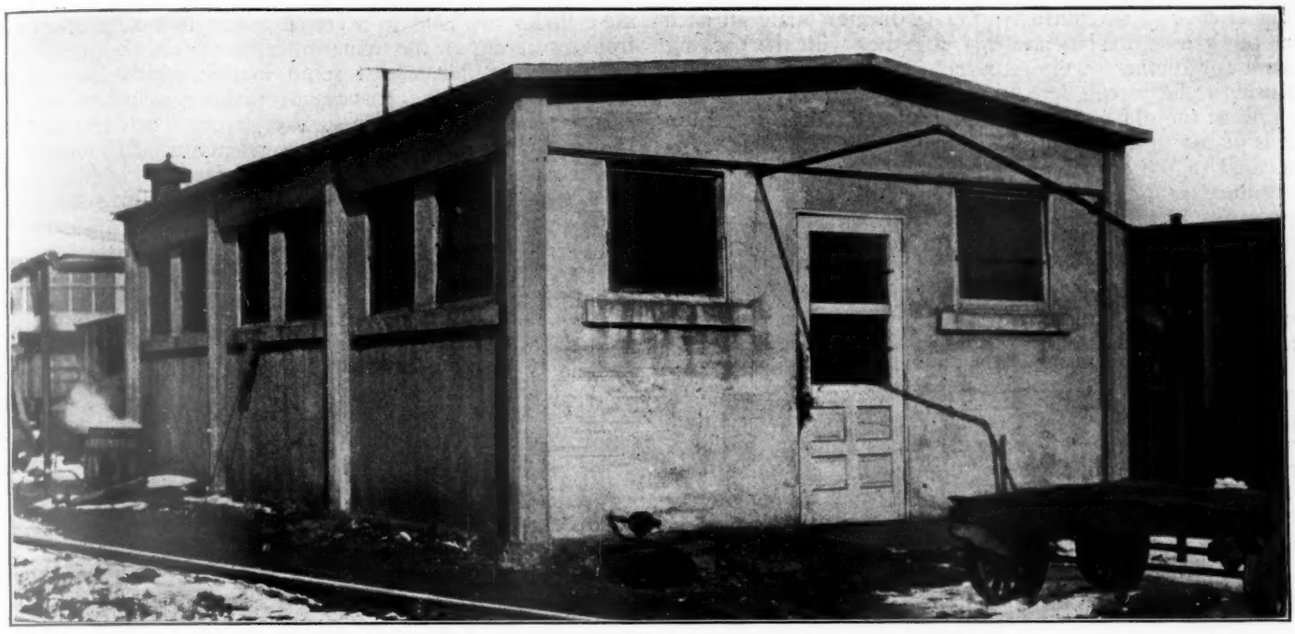


Fig. 1—Exterior view of the oil and waste reclamation plant. A corner of the storage bin for receiving packing to be reclaimed can be seen extending beyond the building at the extreme left.

Reclamation of car journal packing

A description of the system used on B. & L. E. for the conservation of oil and waste

By G. Charles Hoey

Draftsman, mechanical department, Bessemer & Lake Erie, Greenville, Pa.

ONE of the most important jobs that the car department must do to obtain satisfactory car mileage is to provide for the proper lubrication of car journals. It is essential that the proper grade of oil and waste be supplied and the work of packing the

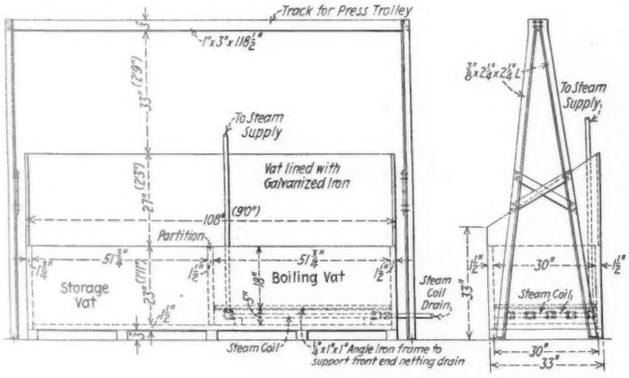


Fig. 2—Vat for boiling and storing reclaimed journal box packing

journal boxes be properly performed. It is has been noted that this particular phase of car repair work was emphasized in the papers submitted in the competition on the prevention of hot boxes which have been published during the past year in the *Railway Mechanical Engineer*. The reclamation of oil and waste is a question of prime importance in the work of car maintenance and in order to make it a real economy, it is essential that proper methods be used.

The oil and waste reclamation plant of the Bessemer & Lake Erie is located at its principal car repair shops, Greenville, Pa. All heavy repairs to steel and wooden freight cars and passenger equipment are performed at these shops. At the present time, the entire product of the oil and waste reclamation plant is used at the Greenville car shops which turns out an average of 25 cars a day.

The work of packing the journal boxes is left until the cars have gone through the repair shop and are spotted on the outbound track for stencilling, and testing of the air brakes. The journal box packing gang, consisting of three men, removes all of the packing from the journal boxes and transports it in low-side steel wheel-barrows to a steel storage bin located just outside the building, as shown in Fig. 1. A load of reclaimed waste is taken on the return trip and the boxes are repacked.

Reclaiming old waste and babbitt

Only one man is employed in the actual work of reclamation. Referring to the drawing of the floor plan, packing is removed from the storage tank to the picking table, which is placed in a convenient position for the attendant to work from the storage tank and thence to the two tanks for boiling and storing the reclaimed "dope." The top of the picking table consists of a screen made of front end netting on which the waste from the old pack-

ing is cleaned and fluffed up. All foreign material such as pin grease, babbitt and dirt, together with the packing unfit for further service is removed by picking or it falls through the screen into a bin underneath.

After the old packing has been cleaned and fluffed up, it is placed in the boiling vat, shown in Fig. 2. This vat is located in the corner of the building at the right of the entrance leading in from the storage tank. It is lined with galvanized iron and is separated from the storage vat by a 1½-in. partition. The packing is supported on a screen made of front end netting placed five inches above the bottom of the vat. Sufficient oil is placed in the vat to cover the "dope." Heat for boiling the oil is supplied by a steam-coil underneath the screen. Under ordinary conditions, a batch of reclaimed "dope," consisting of approximately three wheel-barrow loads, is allowed to remain in the boiling vat for about one hour. However, at times when the car shops are working under unusual business conditions, the "dope" is not allowed to boil more than

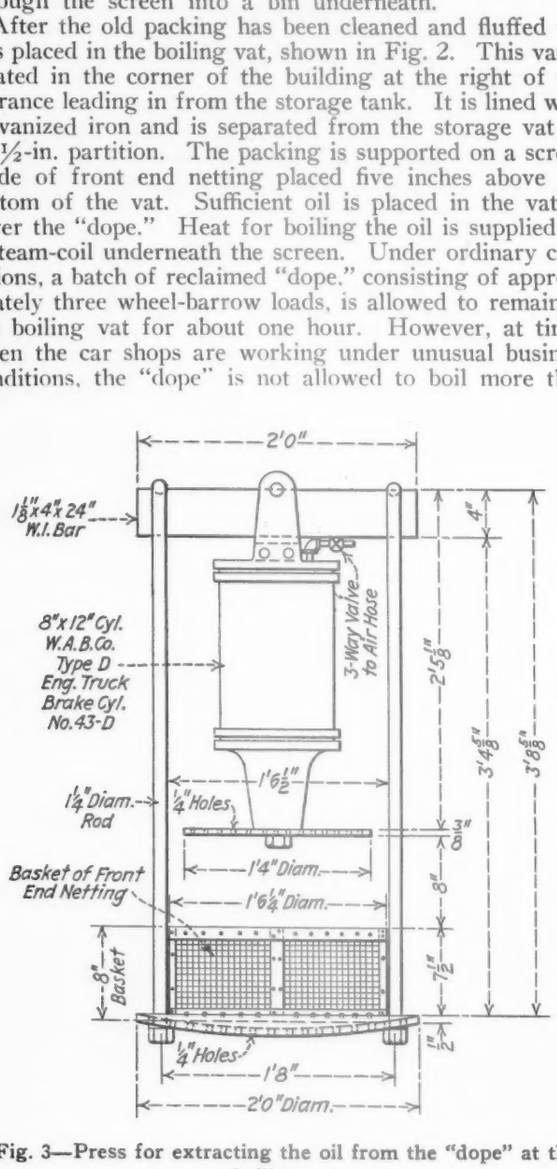
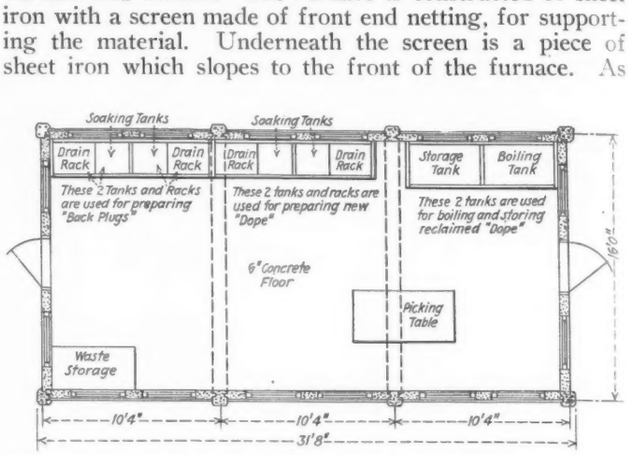


Fig. 3—Press for extracting the oil from the "dope" at the boiling vat

30 min. After the "dope" is boiled, it is pressed in the press shown in Fig. 3 and placed in the storage vat until removed by the journal box packing gang.

The press is carried over the boiling and storage vats on a monorail made of 1-in. by 3-in. flat iron supported on two ⅜-in. by 2¼-in. by 2¼-in. angles placed at the ends of the vats, as shown in Fig. 2. It consists essentially of a basket constructed of front end netting, 18¼ in. in diameter and 8 in. deep. The bottom of the basket is made of a ⅜-in. steel plate, dished as shown in Fig. 3, and is provided with a large number of ¼-in. holes to permit the oil to escape. The work of pressing is done by means of an 8-in. by 12-in. Westinghouse, type *D* engine truck brake cylinder. A ⅜-in. steel plate, 16-in. in diameter is secured to the end of the piston rod which has been turned down to a smaller diameter and threaded for a nut which holds the plate in position. Compressed air can be admitted to the cylinder from the shop air line by means of the three-way valve located at the top. The basket and air-cylinder are held in a frame which is swung from a trolley running on the monorail.

All of the dirt and foreign matter which has been removed during the process of picking is placed in a furnace and burned. The furnace is constructed of sheet iron with a screen made of front end netting, for supporting the material. Underneath the screen is a piece of sheet iron which slopes to the front of the furnace. As

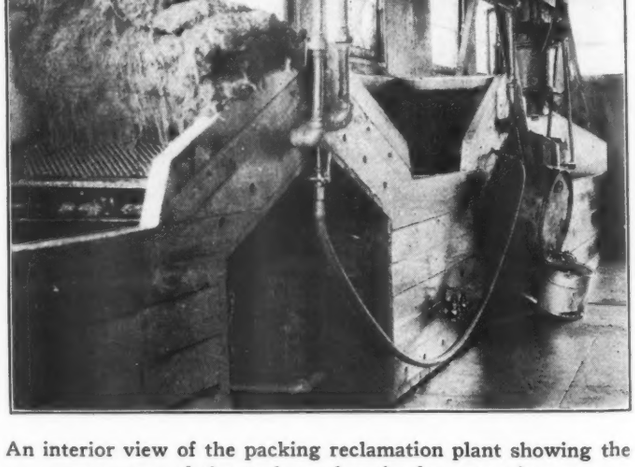


Floor plan of the plant for reclaiming oil and waste for journal box packing

the material burns, the babbitt metal drops through the screen and rolls down the sloping sheet.

Reclaiming the oil

In order to make the reclamation of oil a real economy, it is essential that it be done right. Many hot boxes are caused by foreign substances in reclaimed oil, which collect along the edge of the bearing until the accumulation is sufficient to wipe the oil off the journal. This material also works its way into the bearing, forming a carbon



An interior view of the packing reclamation plant showing the arrangement of the tanks and racks for preparing new "dope" and "back plugs"—The press and boiling vat is shown in the background

coating absolutely void of any anti-friction quality, which results in the gradual heating of the car journal. However, very little trouble of this nature has occurred on the road, due because of the process of filtration used in reclaiming the oil.

As excess oil accumulates in the boiling vat, it is removed and run through a filter. All foreign matter is removed by a process of slow heating, filtration and settling. The filtering apparatus consists of three steel barrels. The first barrel is equipped with a filter or

strainer and has a steam coil at the bottom. A pipe leading from near the top of the first barrel, carries the oil by gravity to the bottom of the second barrel. A similar piping arrangement connects the second barrel to the third barrel which is equipped with a steam coil, like the first, and a cock for removing the oil.

Oil from the boiling vat, which has accumulated from the boiling and pressing process is allowed to thicken and is poured through the filter into the first barrel where it is heated and agitated. As the barrel becomes full of oil, it escapes through the pipe to the second barrel, which serves as a settling tank. As the second barrel becomes full it flows in the same manner as from the first to the

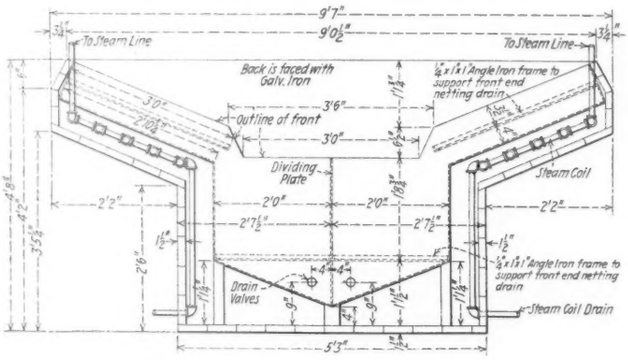


Fig. 4—Vat for soaking and draining new packing

third barrel where it is heated sufficiently to be drawn off and placed in storage.

Ordinary steel tubs are used for the handling of dope in the reclamation plant. All new "dope" and back plugs are soaked for not less than 16 hours in the double compartment vats shown in Fig. 4 and are then placed on the sloping drains as shown in the interior view of the plant, until it is needed by the journal box packing gang.

Practically the entire time of two men of this gang is devoted to repacking journal boxes. The time of the third man is used for packing journal boxes having new wheels.

This plant, which employs one man, supplemented by a gang of three men, maintains an average daily output sufficient for 25 cars. However, providing it is not necessary to use a large amount of new packing, which requires a longer time to soak, an output of 50 cars a day can be readily handled. Old packing is sometimes shipped in from outlying points to be reclaimed, but no special effort is made to collect all the old packing at such points. When a surplus does occur at any outlying point, it is shipped to the plant for reclamation. Old packing from locomotive journals and tender truck journals at the Greenville locomotive repair shops is also reclaimed at this plant and used for car journals.

The car department has entire supervision over this plant. "Dope" is taken from the storage bin as needed, no order or requisition form being used. The plant consumes approximately 12 barrels, containing 52 gal. each, of oil and three bales of waste, weighing 330 lb. each, in 15 working days. It is estimated that each car requires an average of 21 lb. of waste and 9½ gal. of oil.

The London & North Eastern Railway has announced that all passenger train rolling stock which it acquires henceforth will be built on the articulated principle. The company has recently received the first of 29 articulated trains which it has under order, each to consist of two five-coach articulated units. Savings in weight, increase in the comfort of travel and reductions in train length are the principal advantages afforded by articulation.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Switching damage through hand brake failure

Barrett Company, tank car No. 4210, was damaged in switching service on the Chicago, Milwaukee & St. Paul lines. The handling line repaired the car and rendered a bill to the car owner. The handling line contended that the damage to the car occurred in fair usage while the car owner took the position that such extensive damage could not have occurred in ordinary handling, but must have been the result of undue impact occasioned through other than regular switching and that, under section *D*, Rule 32, the handling line was responsible and should issue authority for an offset bill. The Barrett Company in submitting its side of the case to the Arbitration Committee, stated that the tank shifted 5 ft. 6 in. to the B—end, breaking all anchor bolts and tank anchor bands. They claim that this was the result of unfair usage as the car was built in July, 1916, and equipped with center anchorage. The handling line stated that when the rider in charge of the car commenced to tighten the hand-brake, the clevis, which was on the end of the rod and connected with the floating lever, broke under the strain, making it impossible to set the hand brake. Upon inspection, it was found that the break in the clevice was new.

The Arbitration Committee rendered the following decision: "The evidence shows that the handling line provided rider protection and that every reasonable effort was made to protect the car. Therefore, the car owner is responsible."—*Case No. 1923, The Barrett Company vs. Chicago, Milwaukee & St. Paul.*

Depreciation on a destroyed car

On May 15, 1923, Chesapeake & Ohio box car No. 5399 was badly damaged in an accident on the St. Louis-San Francisco. The depreciation statement furnished by the owners shows that the car was built in July, 1914. The repairing line took exception to this date, as the underframe of the car was stencilled "rebuilt June 1910." A representative of the repairing line was sent to the office of the superintendent of the car department of the car owner and was informed that the original C. & O. car No. 5399 was built April 16, 1889, destroyed January 29, 1890, rebuilt June 29, 1899, and sold to a foreign company December, 1915. He was further advised that C. & O. car No. 85399 was built July 10, 1914; after the original car No. 5399 had been sold, car No. 85399 was changed to No. 5399 and that this was the car in question. The St. Louis-San Francisco contended that the depreciation should be figured from April, 1889.

The C. & O. stated that the car in question was built by the Central Locomotive and Car Works, July 10, 1914, and outshopped as car No. 85399, which number was changed to read No. 5399 on the owner's line August 8, 1916. The original car No. 5399 was built April 16, 1899, and was destroyed on the owner's line January 29, 1890, and rebuilt June 29, 1891, and then sold September, 1915. The car owner further stated that none of the

order of cars in which the car in question was included was delivered earlier than 1914. Therefore, the stencilling on the steel underframe showing the car rebuilt in 1910 was in error. The car owner concluded by stating that the settlement made for a car destroyed on a foreign line should be based on the original date built, according to Section D, Rule 112.

St. St. Louis-San Francisco claim that the fact that the underframe of the Chesapeake & Ohio car No. 5399 was stencilled rebuilt June, 1910, was positive evidence that the car was not entirely new when released by the builder July, 1914. Therefore, the depreciation should be figured from 1889.

The Arbitration Committee rendered the following decision: "Additional evidence submitted by the Chesapeake & Ohio substantiates their claim that the car body in question was built new in July, 1914. Therefore, the depreciation should be figured from that date."—*Case No. 1320, Chesapeake & Ohio vs. St. Louis-San Francisco.*

Exceptions taken to the cost of repairs for items listed on defect cards

On November 22, 1922, and June 27, 1923, the Kansas, Oklahoma & Gulf issued defect cards covering defects on T. A. R. X. car No. 2. On March 27, 1923, the Allied Refining Company rendered a bill for $358.51 for repairing the defects. The handling line objected to the bill on account of the repair card not being rendered in accordance with the A. R. A., Rule 7, Section 2, contending that it entitled it to a statement showing the actual material billed for. Exception was taken also to the charge of $58.00 for repairs to the tank head which it refused to pay according to paragraph 2 of Rule 4. The K., O. & G. also took exception to the charges made for replacing the dismantled underframe with another one, because Rule 94 does not cover this item. The Allied Refining Company stated that the defect card was issued several months subsequent to the date on which the damage actually occurred. The repairs were based on prices as covered by the particular code of rules in effect at the time of the accident. The car underframe was scrapped and charges were made against the defect card, according to Rule 94, for material only.

The Arbitration Committee rendered the following decision: "Defect card for delivering line defects should be dated not later than the first interchange of the car. Labor and material prices must conform to the rules in effect at the date of the defect card. With reference to the dismantled underframe, which was replaced with another one, the charge for labor and material should not exceed what would have been required for repairs or necessary renewals of the damaged parts in kind. With reference to the tank head, concerning the cost of repairs of which the car owner is not in possession of definite information, the Committee feels that the charge of $58.00 billed is not excessive."—*Case No. 1327, Kansas, Oklahoma & Gulf vs. Allied Refining Company.*

Another Rule 32 case

On May 17, the Philadelphia & Reading reported that N. O. T. & M. box car, No. 730, was damaged on its lines and requested the Gulf Coast lines to furnish a statement showing the depreciated value of the car. The matter was further investigated and it was found that the car came under the provisions of Rule 120 and accordingly, on May 29, an inspection certificate was furnished.

The Philadelphia & Reading stated that car No. 730, built during 1907, was the tenth car in a draft of 18 cars standing on the south end of a siding. Thirty-two cars were standing on the north end of the siding with a space of about eight car lengths between the two drafts. An engine crew backed eight cars against the draft of 18 cars and started to back a draft of 26 cars against the draft of 32 cars, and when the two drafts came together, car No. 730, the 18th car from the engine, buckled. No derailment resulted and no other cars were damaged in any manner whatever. The handling line further stated that the damage was the result of the weakened condition of the car, as the center sills, having no cover plates and being weakened by corrosion as the result of nearly 15 years service, naturally failed to stand the regular shock of switching.

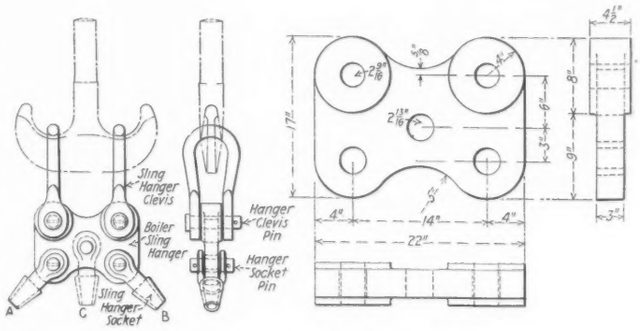
The car owner in making its contention, claimed that upon investigation by its representative, it was found that the damage to the car was due to handling and the failure of the flagman to get his signals to the engineman in order to avoid striking the second cut of cars. The car owner further pointed out that the assistant train master of the handling line recommended suspension and discipline for the members of the crew in their failure to perform their duties properly which resulted in damaging the car, thus inadvertently admitting its responsibility.

The Arbitration Committee in making their decision stated that: "According to the statements submitted by the train crew, signals were given with the intention of having the engineman stop, but the signals were not given in such manner as to be observed by the engineman. Therefore, under Section (d), Item 2, Rule 32, handling line is responsible."—*Case No. 1322, Philadelphia & Reading vs. Gulf Coast.*

Boiler sling hanger for wrecking service

THE boiler sling hanger, shown in the drawing, was designed primarily to be included in the equipment for wreck cranes. It can, however, be used to advantage as part of the crane equipment in tank car shops and in locomotive erecting and boiler shops.

The hanger is forged from a solid piece of wrought



A boiler sling hanger suitable for tank car shops and locomotive erecting and boiler shops

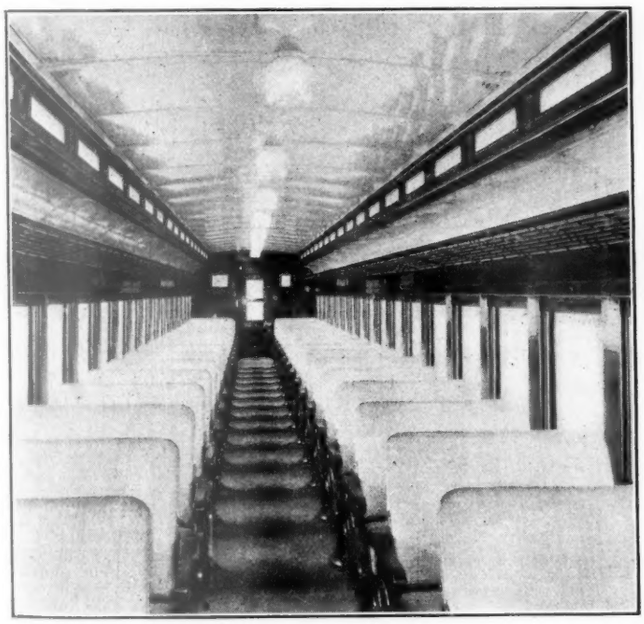
steel and machined to the dimensions shown in the drawing. Referring to the side and end views of the assembly drawing, the calculated working load with the sling attached at *A* and *B* is 150,000 lb. The calculated working load, with a line attached at *C* only, is 125,000 lb. The three slings together are capable of handling any weight of locomotive, boiler or tank.

D. L. & W. Suburban Coach

Suburban cars for the D. L. & W.

All-steel construction with seating capacity of 82 passengers —Total light weight 106,000 lb.

THE Delaware, Lackawanna & Western has recently placed 50 new steel suburban coaches and 10 suburban combination passenger and baggage cars in service between Hoboken and outlying points in the New Jersey suburban district. The 50 coaches were built by the Pullman Car & Manufacturing Corporation



The coaches have seating accommodations for 82 pasengers

and the 10 combination cars were built by the Bethlehem Shipbuilding Corporation, Ltd.

Several important details in the design of the cars are so carried out that they may be easily transferred to and arranged for operation in multiple unit service should the Lackawanna, at some future date, decide to electrify its suburban territory.

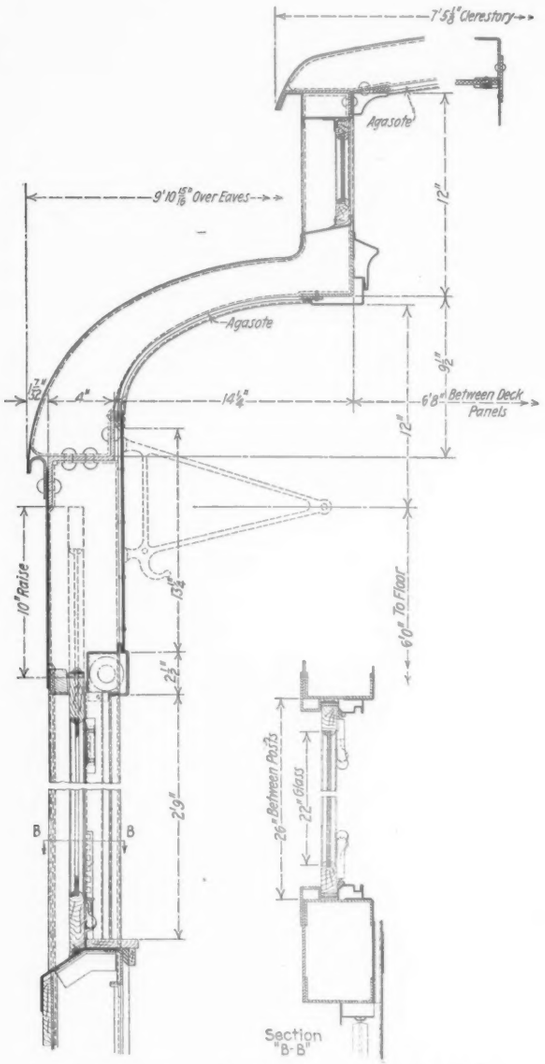
The cars are of steel construction throughout with steel interior finish. The underframe and superstructure details have been so designed as to provide the maximum possible strength consistent with weight limitations. The framing has been designed with a view to providing a car as nearly anti-telescoping as possible. The underframe consists of center sills of the box girder type made up of two 10-in., 23.6-lb. ship channels with 5/16-in. top and bottom cover plates. The center sills extend in one length between the buffer end sills. The side sills are 6-in. by 4-in. by ½-in. angles. The body bolsters are built up of ¼-in. pressed steel pans with bottom cover plates 7/16 in. thick and top cover plates of 5/16-in. steel. The cross bearers are pressed steel pans of ¼-in. plate and extend from side sill to side sill. Floor pans, pressed from ⅛-in. steel plate, extending from center sills to side sills serve as floor supports and provide additional transverse reinforcement to the frame. The bottom floor plates are supported on 5-in. by 3/16-in. floor stringers riveted to the cross members the full length of the body underframe. In addition to the buffing shocks, the underframe is designed to carry the weight of any electrical apparatus which may later be suspended beneath the car.

Details of body construction

The side posts consist of two 4-in. by ⅛-in. pressed steel channel sections placed flange to flange and the corner posts are built up of a 4-in. by 3-in. by 5/16-in. angle and a 4-in., 8.2-lb. Z-bar. The roof framing consists of pressed steel carlines, ⅛ in. thick. The carlines for the lower deck are continuous from the top of the side posts to the under side of the upper deck carlines to which they are riveted and, in fact, form the side posts for the side walls of the clerestory. The carlines are supported by a 4-in. 8.2-lb. Z-bar plate riveted to the side posts.

The side walls are of steel inside and out, except for an interior lining of ⅜-in. Agasote below the window sills to a point 10 in. above the floor. The exterior side sheets have vertical splice plates running from the bottom of the car side to the letter board between the window

openings and, in connection with the window frames, forming the post covers. The exterior belt rail is 4 in. by ½ in. and the letter board is of ⅛-in. steel 12½ in. high, with inside splices and welded joints. The single window frames with welded joints, in addition to forming the sash guides, also act as belt rail caps, side post covers and letter board stiffeners. There are 21 single sash windows on each side of the car. Wood sashes of ⅞-in. Mexican mahogany are fitted in such a manner as to provide unobstructed vision when raised. The window sills are of the same material as the sashes. O. M. Edwards window fixtures are used. The headlining on the lower deck is 3/16-in. Agasote and ¼-in. Agasote

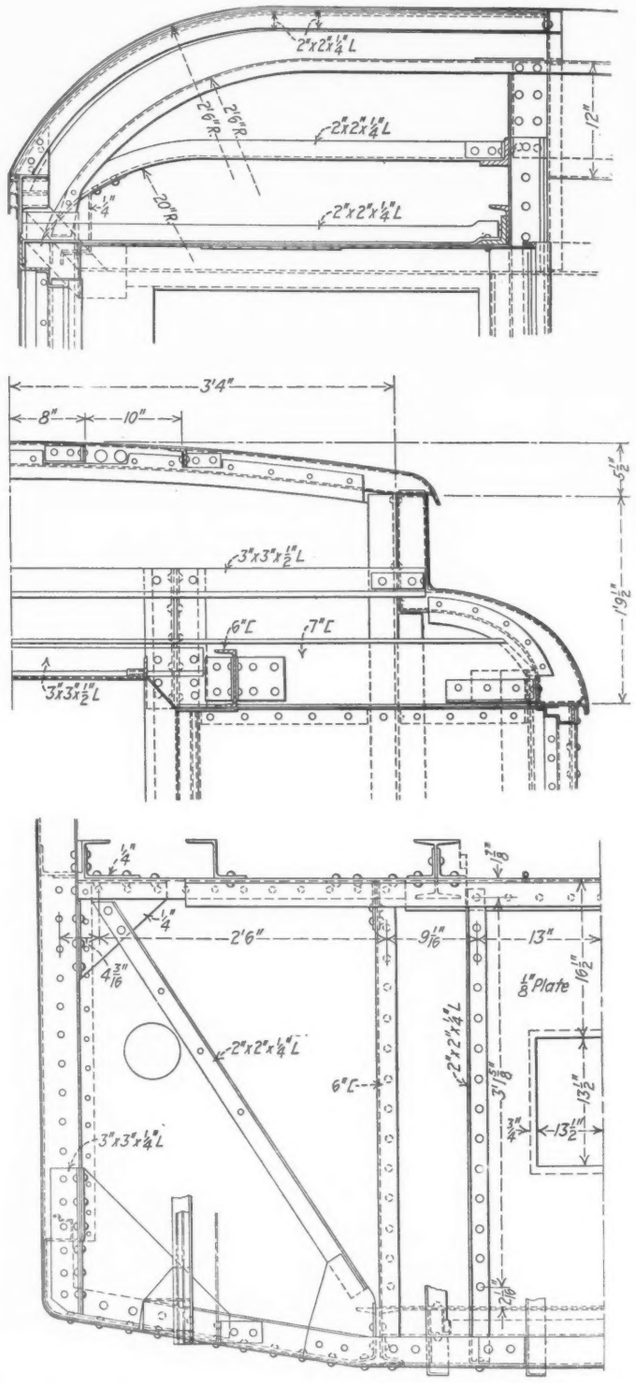


Sectional view of the side walls and roof

is used on the upper deck, all joints being covered with steel battens. The outside roof sheets are No. 14 gage on the upper deck and No. 16 gage on the lower. Swinging window sashes in the upper deck provide ventilation.

The platforms are of built-up steel construction, with cast steel buffer beams, pressed steel buffer wings and ¼-in. platform plate. The floor plate is riveted to the buffer beam, platform arms, center and body ends sills. Box type vestibule frames are provided with each end door post and the corresponding vestibule posts made of 6-in., 23.9-lb. H-beams. The floor and steps are covered with Feralun safety treads and the vestibules are arranged so that end and trap doors may be applied later. The steps provide a passageway 2 ft. 11 in. wide. Vestibule end windows with steel sashes are provided. The vestibule space and window location are designed for the possible future installation of electric control and air brake equipment.

The flooring consists of an under floor of steel plate



Longitudinal (at the top) and cross sections of the vestibule roof and plan of the bulkhead

supported on the underframe, over which is placed one course of ¾-in. 3-ply Salamander insulation. There is an air space between this insulation and the No. 24 gage galvanized steel Chanarch flooring which has ⅝-in. de-

End view of the car showing the box type vestibule with end windows

pressions. This flooring is secured to the floor supports in such a manner as to carry the load independent of the lower or deadening floor. Over the Chanarch is laid a ½-in. layer of Flexolith composition flooring. Around the sides and ends of the car the composition flooring is laid with a cove of about one inch radius to prevent water getting in behind the interior finish when the floor is washed. Next to the exterior side, end and roof sheets is placed a layer of 3-ply Salamander hair felt insulation. Back of the inside finish, below the window stools, one course of ½-in. Salamander is applied. This insulation is covered with cloth on each side and stitched. Insulation is used between the backs of all interior finish sheets and the faces of the framing members in order to break direct metallic connection through the side walls of the cars.

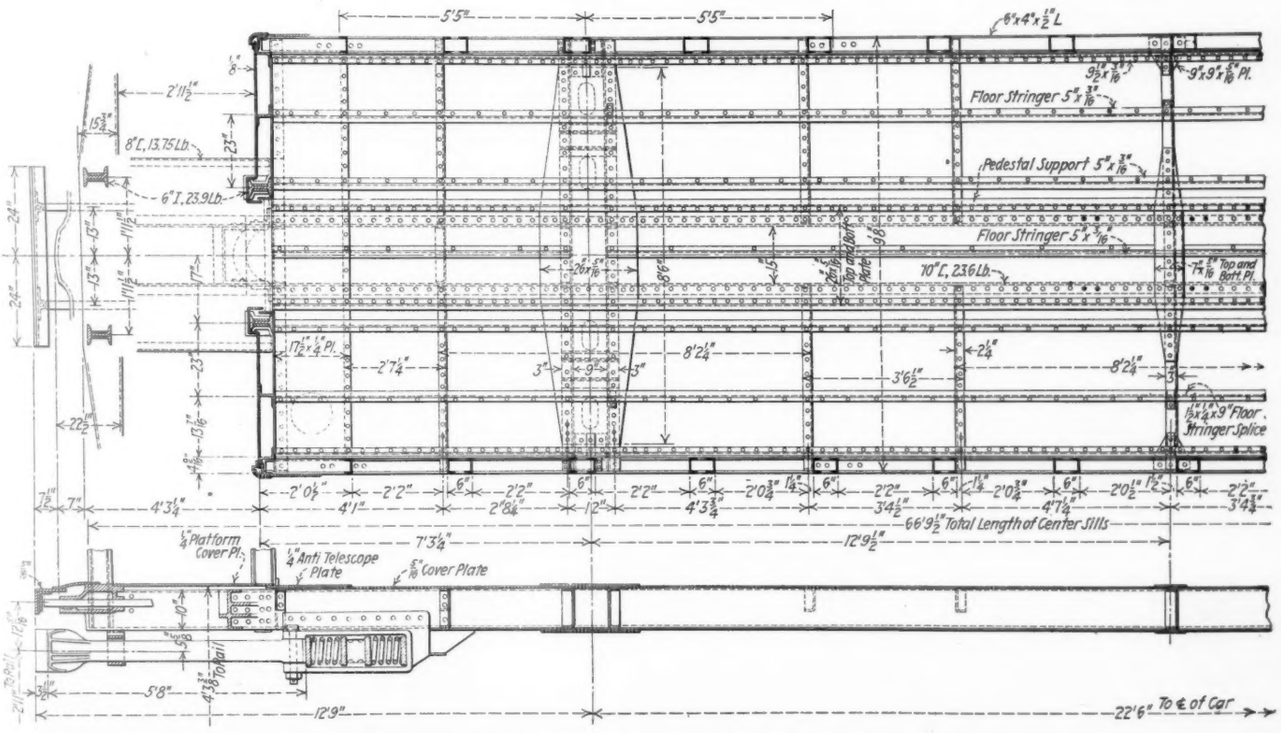
Interior lighting and fixtures

The interior lighting is provided by nine center fixtures fitted with Corona bowls and 50-watt, type "C" lamps. Four flush platform fixtures, one over each step, and one toilet fixture are provided with 25-watt type "C" lamps. The generating equipment consists of a Gould ball-bearing, 30/40-volt generator with body suspension, generator regulator and lamp regulator. A two-compartment switch and regulator panel locker is provided having automatic door-controlled panel lights. The storage battery equipment consists of 16 cells of lead plate battery having a capacity of 200 ampere-hours and housed in a steel battery box.

The latest type of Gold vapor heating system is used in the cars, designed to maintain a comfortable interior temperature. The heating equipment is installed in such a manner that it can be removed at any time without marring the interior and replaced by electric heaters.

The seats are of the Walkover type, manufactured by Hale & Kilburn, with twill rattan fabric cushions and backs and Mexican mahogany arm rests. Continuous steel basket racks are provided. A toilet compartment is built into one end of the car and is furnished with a dry porcelain hopper. Recessed into the toilet room is a water cooler accessible from the car body only.

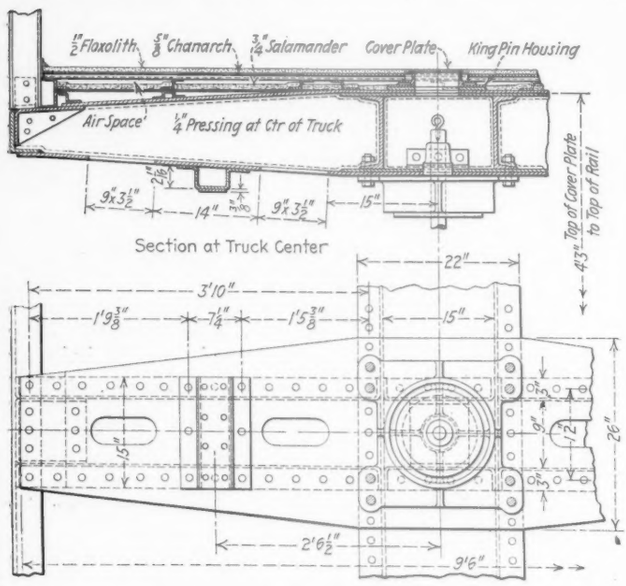
The metal interior finish is surfaced and two coats of light mahogany inside enamel applied. The headlinings



Underframe construction of the D. L. & W. suburban cars

are light in color and protected by three coats of finishing varnish. Gold leaf lettering is used both on the interior and the exterior of the car.

The cars are equipped with the Westinghouse UC air



Construction of the body bolster

brake equipment arranged for clasp brakes and slack adjuster, to provide a braking power of 90 per cent of the light car weight with a brake cylinder pressure of 60 lb. All brake rigging is designed with ample strength for 105-lb. cylinder pressure. Miner friction draft gear and buffer attachments are used. The couplers are Gould long shank passenger type.

The trucks are of the four-wheel type with the Commonwealth Steel Company's one-piece cast steel truck frames, cast steel truck bolsters, 5-in. by 9-in. journals and 36-in. rolled steel wheels.

The light weight of these cars is approximately 106,000 lb. and, with a seating capacity of 82 persons, the weight per seated passenger is slightly less than 1,300 lb. The height is somewhat less than existing equipment and the roof structure is designed for the future application of a pantograph and headlights.

The 10 combination passenger and baggage cars mentioned in the first paragraph are of substantially the same design and equipment, having a baggage compartment with an inside length of 17 ft. 3 in. The passenger compartment has a seating capacity of 58 persons. The light weight of these cars is 106,700 lb. and the weight of the two trucks complete is 32,200 lb. Some of the more important dimensions of the coaches are given in the table.

Principle dimensions of D. L. & W. suburban coaches

Length over buffers	70 ft. 6 in.
Length over end sills	59 ft. 6½ in.
Length center to center of trucks	45 ft. 0 in.
Width over side sills	9 ft. 8 in.
Width at eaves	9 ft. 11 in.
Width over clerestory	7 ft. 5⅛ in.
Height from top of rail to top of roof	13 ft. 0 in.
Height from top of rail to bottoms of side sills	3 ft. 6 in.
Height from top of rail to center of drawbars	2 ft. 11 in.
Height from top of floor to ceiling in center of car	8 ft. 3 in.
Seating capacity—coaches	82 persons
Seating capacity—comb. baggage and passenger	58 persons

The maintenance of steel cars*

By J. A. Roberts

Chief A. R. A. clerk, Chesapeake & Ohio

THE subject of steel car maintenance is a vital one to coal-carrying roads that have to rely on foreign roads to maintain their steel cars while off of home lines.

The wooden coal car had been developed to carry 80,000 lb., when the first all-steel coal cars came into use, which were of 100,000 lb. capacity. Many railroads hesitated to adopt the steel car. Car repairers were not trained to remove riveted parts, straighten and reapply. Pneumatic and electric tools were practically unknown, making repairs slow and difficult and many were afraid that the car would rust out in three or four years. But, after a number of them were put in use and it was shown that the earnings from increased capacity of the car alone would pay for the car within three years, the situation then changed and the steel car was adopted by various railroads, until today, it is used on practically every railroad in the country.

The design of steel cars has been improved on to such an extent that some railroads now have such equipment with a carrying capacity up to 120 tons per car. Therefore, you can realize that with cars of this class, necessitating an enormous outlay of money, the equipment should receive every possible consideration in keeping it in first class condition, using facilities for mantenance that will hold the cost down to a minimum.

A record should be kept of the nature of repairs to be made to steel cars, indicating on forms similar to that illustrated, parts that will have to be renewed. With a record of this kind, you can determine what parts will be required for renewal in your heavy repair program and will enable you to order only material that will be needed, thereby keeping down a surplus stock of material. It has been found that steel car material carried in stock for any great length of time deteriorates almost as fast as the material in cars, therefore, it is important to carry in stock as little of this material as possible.

Concerning the deterioration of steel equipment: It has been found that at least 90 per cent of the deterioration of steel cars is on the inside of the cars and it is caused by sulphurous acid in coal. The cars can not be protected on the inside with paint, because it is scraped off in a very short time by mechanical abrasion.

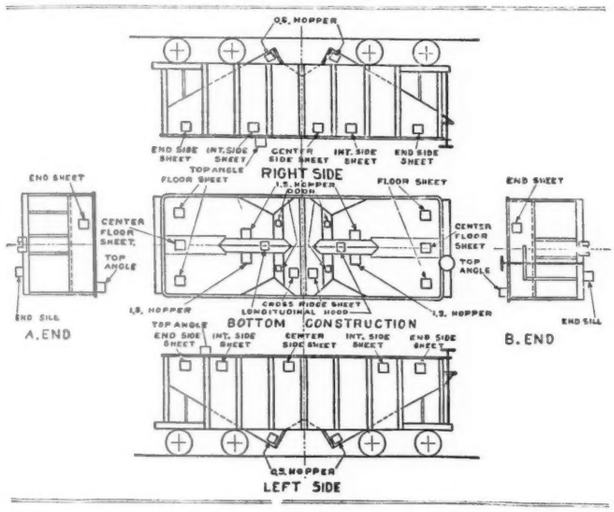
This deterioration could be cut down to a minimum if the cars were used for transportation only, but in many cases, they are used for storage of coal and the sulphur that is found in coal forms a weak acid with the moisture or water in the coal, which, if allowed to stand in a car any length of time, causes the insides of cars to deteriorate quickly. On the other hand, if used for trans-

*Abstract of a paper presented at the annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association at Chicago, September 23, 24 and 25, 1924.

portation only, the coal is in motion, which will not allow the acids to accumulate in any one place, and the motion of coal will keep the metal smooth and free from corrosion. There is, however, some deterioration from corrosion on the outside of cars and it is good practice to scrape off all rust with steel scrapers and wire brushes and paint the cars as fast as they begin to show any amount of rust.

It has been claimed by manufacturers that copper-bearing steel subjected to sulphurous acid will not deteriorate as fast as ordinary steel and quite a few roads are purchasing cars built with copper-bearing steel. It is claimed

REPORT OF NEW STEEL PARTS APPLIED TO 55 TON AND 57½ TON H. B. G. STEEL COAL CARS WHEN GIVEN CLASS 4 OR 5 REPAIRS



Car No._____ Initials_____ Place_____ Date_____ 192__

Signed_____
Car Foreman

INSTRUCTIONS

This report must be made for each 55 ton and 57½ ton H. B. G. Steel Car when given Class 4 or 5 Repairs by inserting the letter "X" in the square on each piece that is applied new, and mailed to the Supt. Car Dept. when the repairs are completed.

No parts are to be marked on this report that are removed for straightening or any other cause and replaced.

Sample form for recording repairs made to steel cars

that steel with .15 to .28 per cent copper will resist corrosion longer than ordinary steel and the American Railway Association, in its recommendations of specifications for steel shapes in Circular DV-282 Exhibit "D," recommends that when copper-bearing steel is specified, the copper content shall not be less than .20 per cent.

Method of repairing cars

In my opinion, the progressive plan of repairing steel cars should be installed in all principal shops. Roads having sufficient equipment should select cars of the same design and condition for repairs in sufficient numbers to fill out a repair track for as long a period as possible. A car requiring other or more extensive repairs will hold back the cars behind it. Cars of other designs will require more or less time for the different operations and interfere generally with the program. Place the cars on a track after the rivets have been burnt out by an electric burning outfit and specially assigned gangs detailed to do a certain class of work to these cars, until they are ready for the shipping tracks. The different operations will be as follows:

First—The cars are placed on a track equipped with the following electric rivet-burning apparatus—a motor generator set, supplying a direct current not exceeding 80 volts with the necessary capacity in amperes. This is governed by the number of cutting units used. Each cutting unit takes from 400 to 500 amperes. The generator should be located as close to the cutting tracks as possible, to prevent excessive voltage drop. The lead wires from the generator to the cutting stations should have ample cross-sectional area to prevent excessive power loss. In order to prevent the necessity for ladders or movable scaffold, a permanent scaffold should be located the entire length of each side of the burning track about six feet high and having a platform width of about two feet. The framework of this scaffold can be used in place of a pole line for carrying the supply wires, which should have plug-in stations approximately 35 ft. apart. The burning tool consists of a graphite stick held by a suitable handle with sufficient area to prevent excessive heat as a result of the heavy current carried. The rivets in the defective parts are burned out by this process and backed out with nine-inch hammers provided with suitable pneumatic tools. One operator can burn out from 1,000 to 1,500 rivets in eight hours and an operator with a pneumatic tool can back out from 1,500 to 1,800 in eight hours. Comparing this with the rivet-cutting gun, there can be a saving made of approximately 50 per cent in labor and this method does not damage the sheets to any extent, compared with what occurs in using the rivet-cutting guns. If a sheet is thin, the rivet-cutting gun will tear it. This does not occur while using the electric rivet-burning tool. It also practically eliminates accidents due to flying rivets and is a protection to operators.

Second—This operation consists of stripping the car of defective sheets and parts, which should be done before the car is placed on the repair track where it is to be reassembled. This is done in order to keep the working track free from scrap material, which, if allowed to accumulate, is a hazard and will hamper the workmen.

Third—The car is then set on the repair track, trucks

Cutting rivets with electric burning outfit

removed and car body set on tripods, or benches. After the entire line of cars have been jacked up and trucks removed, they are repaired by the following gangs:

Gang No. 1—This can consist of two car repairers and two helpers equipped with special tools. It repairs all trucks and removes and repairs all couplers.

Gang No. 2—One car repairer and one helper. This gang may start in at the same time as Gang No. 1 to straighten all bent parts on the car, set up all flanges and prepare the car for the fitting-up gang.

Gang No. 3—Four car repairers, two apprentices and two helpers. Operation 1—Fitting up all inside and outside hopper sheets, cross ridge sheets and longitudinal hoods. Operation 2—Fitting up all floor sheets, tie beams, side and end sheets. Opera-

tion 3—Fitting up all splices, end sills, body bolsters and all angles.

Gang No. 4—One car repairer and one helper whose duties will be to ream all holes.

Gang No. 5—Two car repairers, one apprentice and one helper. Operation 1—Riveting up all inside and outside hopper sheets, cross ridge sheets and longitudinal hoods. Operation 2—Riveting up all splices, end sills, body bolsters and draft lugs. Operation 3—Riveting up all floor sheets, side and end sheets and all angles.

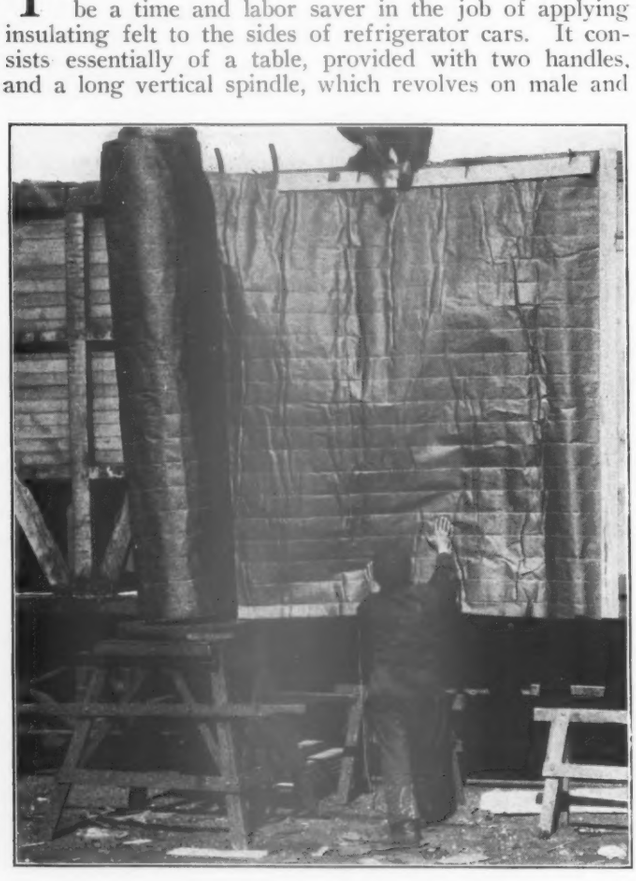
The cars are then painted and stencilled, air brakes tested and thoroughly inspected before being returned to service. Of course, the above gangs can consist of more men, as conditions may require.

Conclusion

If the car is properly repaired, it will give good service for at least 10 years before it will have to be shopped for heavy repairs, unless the car is in an accident, as the floor sheets and outside hopper sheets will last about 10 years before needing renewal, while the side and end sheets will last approximately 15 years before needing new sheets.

Applying insulation to refrigerator cars

THE carrier shown in the illustration has proved to be a time and labor saver in the job of applying insulating felt to the sides of refrigerator cars. It consists essentially of a table, provided with two handles, and a long vertical spindle, which revolves on male and female center plate castings. The table is built high enough so that the edge of the roll of felt comes even with the lower edge of the side sill. The spindle is made from a jack handle, fitted into the base on which the end of the roll of felt rests. The male center casting is bolted to the base of the spindle and it turns on the female center casting, which is bolted to the top of the table. The jack handle extends down through the king pin hole of the center casting about 18 in., so that the lower end will turn in a socket underneath the table top.



The carrier holds the roll of insulation felt in a vertical position so that two men can easily apply it

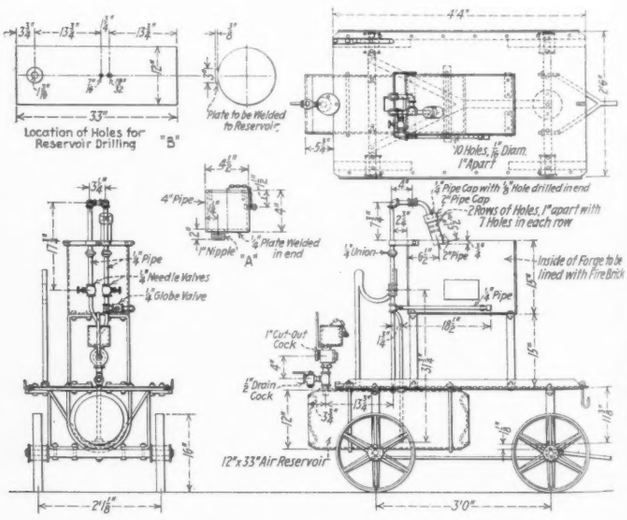
In order to place the felt on the carrier, the roll is laid on the ground, the spindle is removed from the table and thrust into the center of the roll. The table is tipped forward and the pivot end of the spindle is placed in the hole in the table top. The top end of the roll is then raised and as it approaches the vertical, the spindle slides into place in the lower socket.

The carrier is placed so that the felt will unroll on the side next to the car. The end of the felt is secured at the door post and the carrier is then moved along the side of the car and around the end to the other side as the mailing strips are applied.

A portable forge for heating rivets

THE portable rivet heating forge, shown in the drawing, was constructed in the shops of an eastern railroad. It has proved to be useful to the rivet gang engaged in steel car repair work when moving from station to station. The forge is supported on two brackets 15 in. above the bed of the wagon. This arrangement provides space for small tools and rivets underneath the forge, as well as additional carrying space in front of the forge for large tools. A hook over which the air hose can be looped while the forge is being moved is secured to the wagon bed between the forge and air inlet cock, as shown in the drawing.

The apparatus consists essentially of a flat topped wagon, a 12-in. by 33-in. air reservoir *B*, an oil burner, and a furnace which is constructed of ¼-in. rolled steel and lined with fire brick. Referring to the side view of the forge in the drawing, the air reservoir is filled with fuel oil by means of a cup or funnel, a detailed drawing of which is shown at *A*, the lid is secured by a chain to prevent its being lost. Directly underneath the cup is a 1-in. cut-out cock and a 1-in. by 1-in. by ½-in. tee. This cock must be kept closed at all times, except when



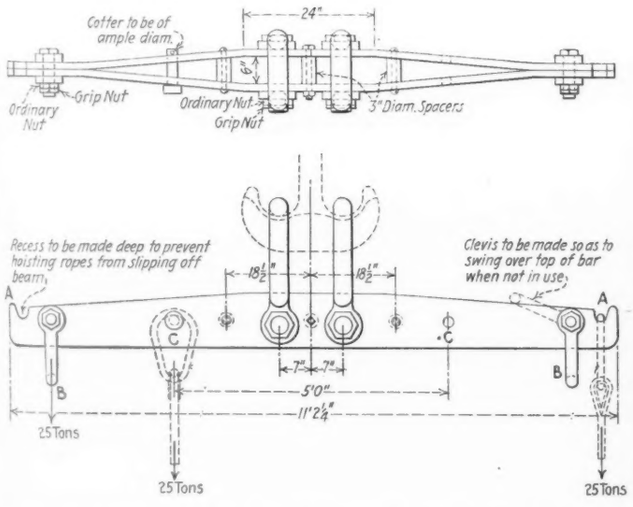
A portable rivet heating forge designed primarily for use on steel car repairs

refueling. The air hose is attached at the cock on the horizontal branch of the tee. Compressed air from the shop line is admitted to the oil reservoir as desired by opening or closing this cock. The pressure of the air exerted on top of the oil in the reservoir forces the oil up through a ¼-in. pipe, leading from a point near the bottom of the reservoir, to the burner. Air for atomizing the oil is taken from the top of the reservoir by a second ¼-in. pipe which is joined to the fuel oil pipe by a tee which is located about 15 in. above the bed of the wagon.

With the exception of the wheels, which are of gray iron, pipe fittings and burner, all of the various parts used in the construction of the apparatus are of forged or rolled steel. Two 2-in. by 2-in. by ¼-in. rolled steel angles from the sides of the wagon bed. The oil reservoir hangers are made of ½-in. round bar, bent U-shaped and threaded at the ends. The wagon tongue is forged from ½-in. by 1½-in. flat bar and is 37½ in. long. A hook is provided for holding the wagon tongue up out of the way when the forge is not being moved.

Hoisting beam for wreck cranes

IT is essential that a variety of hoisting equipment necessary to meet the numerous conditions encountered in clearing up wrecks be provided on the wreck train. The hoisting beam, shown in the drawing, is included in the wreck crane equipment on an eastern railroad. It is not only suitable for wrecking service, but may be also included as a part of the crane equipment in the locomotive erecting shop. The beams are of wrought



Hoisting beam suitable for either wreck crane or locomotive erecting shop service

steel designed to carry a load of 50 tons with a factor of safety of five.

Any of the link or cable combinations, such as *AA, BB* or *CC*, may be used as desired. However, no combination, such as *AC* or *BC* on opposite sides of the fulcrum may be used on account of unbalancing the load on the beam. The two sections which compose the beam are held apart at the center by means of hollow spacers held in position by coupler yoke rivets. Care should be taken to make the recesses at the ends of the beam deep enough to prevent any possibility of the hoisting ropes slipping off the ends.

Convenient ladders for the coach cleaners

A LADDER is undoubtedly, the most important part of a coach cleaner's equipment. Possibly, the best type of ladder for this work is one having a step wide enough to support a part of the heel and ball of the foot. A step similar to the ones illustrated, provides a

This type of ladder provides a substantial support to work on —Note that the box is open at the top, making it convenient of access

more substantial footing for the cleaner and he feels safe while using both hands in his work. Furthermore a ladder with wide steps is not so tiresome to the feet as a rung ladder.

The coach cleaner's ladders, shown in the illustration,

Front and rear views of a coach cleaner's ladder, showing the side opening to the box and the pad on the back to prevent scratching

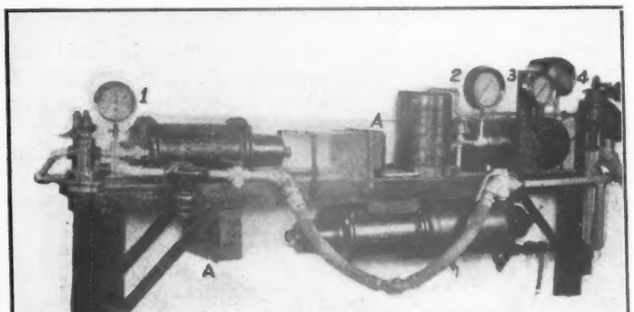
are examples of the kind used on the Delaware, Lackawanna & Western at its Hoboken, N. J., terminal and in the coach yard at East Buffalo, N. Y. They are not only built with wide steps, but boxes are also provided for holding cleaning materials. After the cleaner has once started to work, it is unnecessary for him to descend the ladder until the job is completed or the ladder has to be moved further along the car. Pads are placed on the back to prevent scratching the side of the car.

Air brake equipment at Rice Institute

By J. H. Pound
Assistant professor, mechanical engineering, Rice Institute, Houston, Tex.

DURING the past winter the mechanical engineering department at Rice Institute, Houston, Tex., constructed an arrangement of standard air brake equipment for the purpose of demonstrating the principles and routine operation to engineering students. On account of crowded laboratory conditions it was necessary to build the apparatus so that it would occupy a very small space.

This apparatus consists of a driver brake cylinder and detached auxiliary reservoir with a plain triple valve and double spring retaining valve, a standard combined freight car cylinder and auxiliary reservoir with a quick-action triple valve, and an engineman's brake valve complete with feed valve, equalizing reservoir, and duplex gage. The brake pipe contains the usual cut-out cocks, centrifugal dirt collector and hose connections. This equipment



Air brake apparatus constructed for purposes of demonstration to technical students

is mounted on a heavy wooden bench made of 4-in. by 12-in. timber, as shown in the illustration. Compressed air is supplied by a single stage, steam-driven locomotive type air compressor provided with a governor and main reservoir which had previously been installed in the laboratory.

When air is admitted into the brake cylinders, the thrust of the pistons is taken by the 8-in. steel angles *A* which are faced with hard wood and bolted securely to the bench. The pressure changes in the main reservoir and train pipe are recorded from the duplex gage. Gages *1* and *4* show the pressures in the driver brake cylinder and detached auxiliary reservoir during the various operations, which are performed both with and without the pressure retaining valve cut in. Gage *2* is connected to the auxiliary reservoir of the freight car cylinder and serves to show the difference in equalizing pressure existing with plain and with quick action triple valves after an emergency application. An emergency application is made by disengaging the hose coupling. The travel of the driver brake piston sleeve is protected with a wire guard.

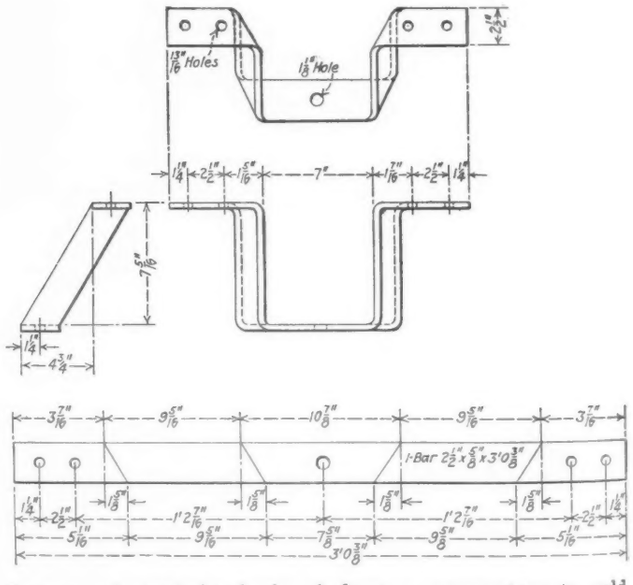
The instructor in demonstrating goes through certain operations which are briefly described on a mimeographed form supplied to each student. The readings of the gages during these operations are noted and recorded in blank spaces on the form opposite the description of the changes made in the brake valve positions. The student is required to write a description of the action of all the mechanisms involved in the operation he has witnessed. By means of this demonstration and a written report, the students get a much better idea of the operation of an automatic air brake system than they got by the old method of instruction.

This apparatus occupies a floor space approximately 17 in. by 9 ft. 8 in. It could probably be assembled at any school, from new parts, at a cost of between $200 and $225. Such equipment in a laboratory furnishes a means of demonstration of the possibilities of compressed air as a control medium which is useful even in engineering schools where special courses in railway mechanical engineering are not offered.

Forming brake shaft steps from cold stock

By Harry R. Taube

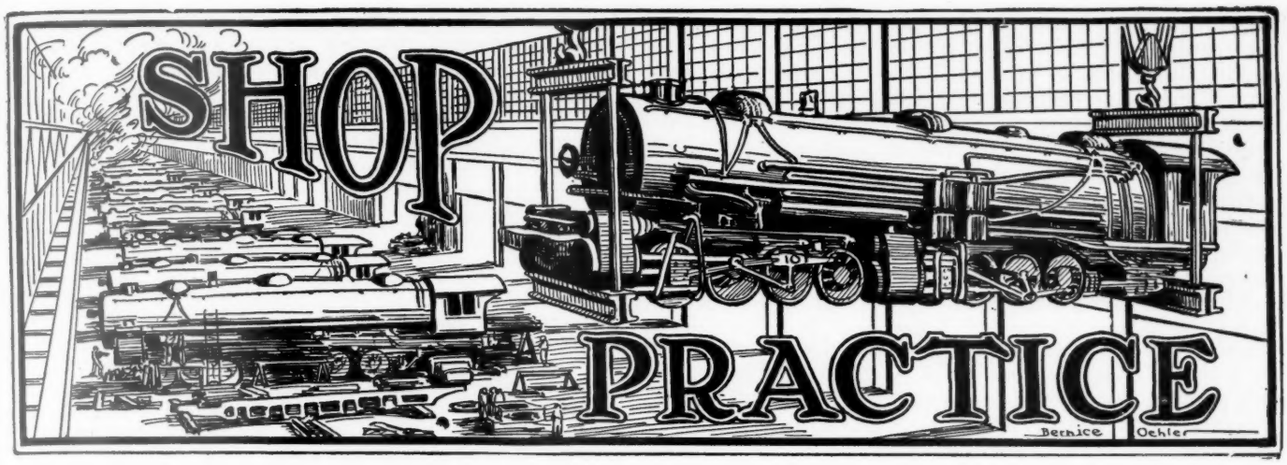
THE accompanying illustration shows a method of cold forming brake shaft steps which has been developed in the Palatino shops of the American Steel Company at Havana, Cuba. The ordinary run of steel stock is used. In following the dimensions on the lay-out, it will be noted that the angles are laid obliquely,



Lay-out of stock for brake shaft steps preparatory to cold forming

as the purpose of this is to permit the offset to be formed by cold bending across the flat of the material rather than by hot bending edgewise.

This job can be done on a bulldozer in one set up. The ram forms the bottom of the bracket while two expanding toggles form the lugs. As the cost of fuel is high in Cuba, a considerable saving is effected by this method.



Case carburizing and hardening valve motion parts

The steel, carburizing agent, temperature and time element are essential factors

By J. E. Burns, Jr.
Member, research staff, E. F. Houghton & Co.

THE object of case carburizing and hardening valve motion parts is to secure a hard wearing surface on low carbon steel or iron, and the retention of toughness in the core of the metal used. The process can be roughly divided into two distinct operations, namely: the carburization or cementation of the surface by which the carbon content is sufficiently raised to insure the abrasive value and hardness desired, and to provide for a suitable heat treatment which will develop the desired physical characteristic of both the case and the core. The complete operation should not only result in obtaining a very hard case, but also non-brittleness in the core, thus producing link motion parts, which shall possess a minimum fragility and a maximum abrasive (hardness) value.

Essential factors in carburizing operations

The following four factors must be appreciated in detail if satisfactory valve motion parts are to be produced. They are the steel, the carburizing agent, the temperature and the time element.

The character of the steel or iron used for motion work is governed, in no small measure, by the fact that one of the essential factors is to eliminate brittleness in the core. It is an accepted engineering fact that the higher the carbon the greater the brittleness, particularly when the carbon content is .25 per cent or over. Furthermore, as practically all commercial carburizing practice is followed by one or more heat treatments for toughening and hardening, it follows that the use of steel with a high carbon content will also increase brittleness in quenching. For these reasons it is apparent that the carbon content in motion work should be low. On the other hand if the carbon content is too low, extreme difficulty is encountered in the machining operations. The low carbon results in a very mushy and rough surface, necessitating a greater depth of case than otherwise would be necessary to allow for the increased grinding tolerances necessary in order to secure a smooth surface after the hardening operation. For the above reasons the general American practice is to adopt a carbon content of approximately .10 to .20 per cent, .15 per cent being the desired amount.

From .30 to .35 per cent manganese is considered most desirable, as it is a well established fact that a higher manganese content renders the steel, as a whole, more sensitive to rapid cooling, while increasing the hardness of the case causes a corresponding and detrimental stiffening of the core.

The impurities, silicon, sulphur and phosphorus, should be just as low as is possible to secure in commercial steels as slag, blow holes, and segregations should be entirely absent.

Carburizing agent

Carburizing or cementation by its very nature demands the presence of free carbon in some form or another; either in a solid body or by the presence of a gas which will liberate free carbon by the process of decomposition. The mere presence of free carbon by contact with iron or steel will not satisfy the conditions for successful carburizing.

Science tells us that compounds evolving carbon monoxide or hydro-carbon gases alone have definite outstanding advantages, but for commercial endeavor they have many objectionable features. Combinations of compounds insuring the evolving of both these gases produce the most satisfactory medium for general commercial work, and such compounds are considered standards in many large industries.

Wood charcoal, which is sometimes used in the presence of a catalytic agent, has a definite tendency to develop

cemented zones of low and irregular carbon content. It also causes internal combustion in the carburizing pot, making it impossible to control the carburizing temperature. This is an objectionable condition as temperature, in the largest measure, controls the carbon content.

Animal charcoal such as charred leather, bone, horn, etc., are objectionable in themselves as carburizing agents. Grayson has produced incontrovertible evidence that sulphur will diffuse into iron or steel at temperatures used for carburizing with such substances as above mentioned, and that this sulphur combines with manganese and iron to form manganese and iron sulphides resulting in soft spots.

Referring to Fig. 1, it will be noticed that there appear on the edges large quantities of sulphide of manganese and also sulphide of iron with ferrite crystals intermingled. This sulphur diffusion is serious in valve motion work, because it produces soft spots, and when present in smaller quantities, will have a tendency to cause chipping of the case, thus producing two objectionable effects which should be avoided if satisfactory service is to be expected. Hence, any compounds manufactured by reliable commercial firms are much more to be desired than questionable home-made products.

The compound yielding both hydro-carbon and carbon monoxide gases in fixed percentages will insure satisfactory results, all other factors being equal. It is the experience of manufacturers that it is impossible to manufacture a carburizing material which will give uniform results, unless the energizers are attached to the grains of the carbon, either by impregnating or binding. The most uniform results are obtained from a compound made of grains of charcoal leather and wood charcoal suitably impregnated with energizers and then baked. Such a compound, when first used, will char the binder which will hold the energizers to the grain, thereby producing continuous uniform results, during the life of the compound. Such a compound evolves both carbon monoxide and hydro-carbon gases and is preferable to all others for general railroad purposes.

Temperature and time factors

Carburizing gases, by diffusing into steel, precipitate free carbon. This carbon, under suitable condition, will be dissolved at once by the iron, forming a true steel. The solubility of this carbon depends upon the temperature. If a piece of steel desirable for motion work, containing from .10 to .20 per cent carbon, is heated, none of the Cementite, which is mechanically mixed with Ferrite (iron) to make the mixture Pearlite, is effected until the lower critical temperature (1,350 deg. F.) is reached. At this temperature, the iron of the Pearlite changes and dissolves the Cementite, the two forming a solid solution called Austenite. As the temperature is progressively raised, more of the excess iron is dissolved by the Austenite until the so-called Ac 3 range is reached. At this point the entire mass of steel consists of Austenite.

It is thus possible for carburization to take place at temperatures between the Ac 1 and the Ac 3 ranges (the lower and upper critical points). The carburizing action, however, must necessarily be not only slow, but also irregular and non-uniform. The minimum temperature used should not be lower than the upper critical range, approximately 1,625 deg. F. The recommended furnace temperature is 1,700 deg. F.

All commercial carburizing processes must provide a depth of case which will satisfy the requirements. Thus

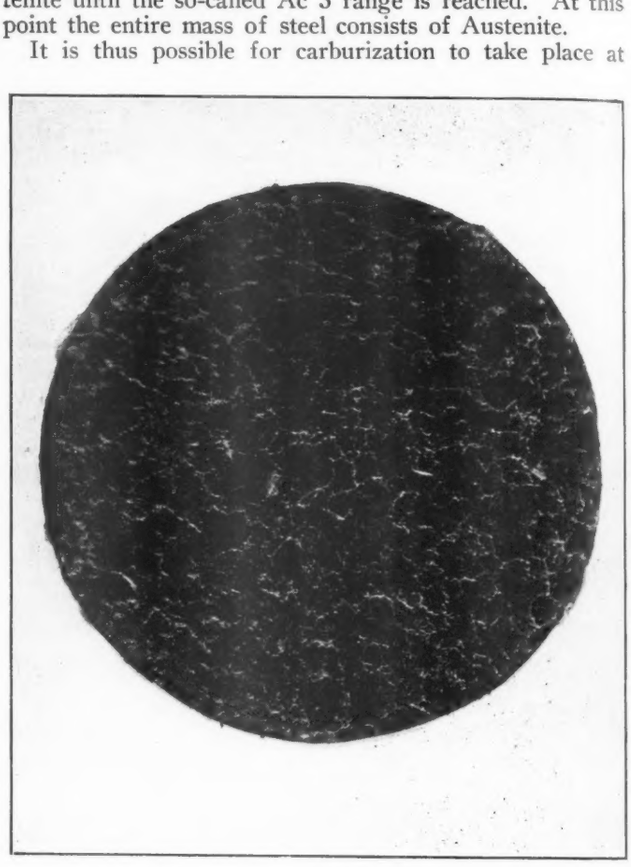


Fig. 1—Hypereutectoid case showing improperly deoxidized or abnormal steel—The small, curly, but numerous ridges of excess cementite indicate that the steel is of poor quality

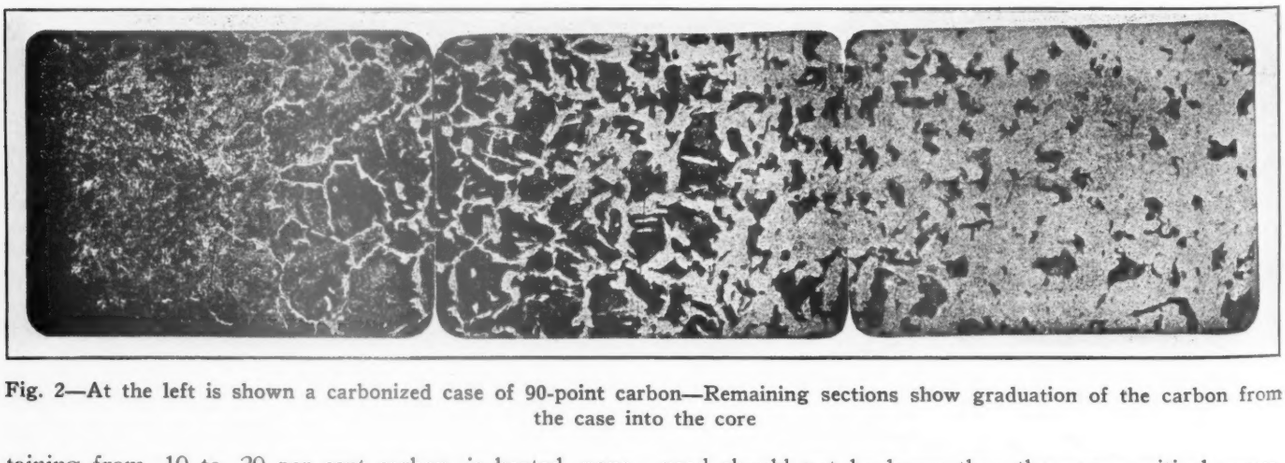


Fig. 2—At the left is shown a carbonized case of 90-point carbon—Remaining sections show graduation of the carbon from the case into the core

valve motion parts should have sufficient depth to allow for any grinding and the low allowable limit for serviceable use.

Depth of penetration is regulated by the time factor

With a definite depth in view, economic considerations require that the velocity of penetration shall be definitely known in relation to the factors of time, temperature and carburizing agent. It is generally understood that the depth of penetration and carbon content increases with the temperature and time elements. A properly carburized valve motion part should show a gradual decrease in carbon content from about one per cent on the surface to that of the initial content in the core of from .10 to .20 per cent. This structure is shown in Fig. 2.

The case should develop traces of hyper-eutectoid structure (.95 to 1.00 per cent carbon). This will insure the proper development of the desired hardness without danger of enfoliation (chipping of the case). Fig. 3 shows the development of this granular formation.

Fig. 3—Hypereutectoid case of normal steel showing, at the bottom, a network of cementite around the grains of lamellar pearlite—The network at the top indicates traces of the hypereutectoid structure—The dark area in the middle is the eutectoid zone

The hyper-eutectoid structure starts to develop at the point of saturation and at temperatures about 1,700 deg. F. The eutectoid zone is the saturated condition and hypo-eutectoid is indicative of non-saturation, which is shown in Fig. 2. Both the hyper-eutectoid and the eutectoid zones will develop maximum hardness. The hypo-eutectoid zone (lower than .90 per cent carbon) cannot insure this condition. Low carburizing temperatures invariably develop the hypo-eutectoid structure and are often the direct cause of soft work. Valve motion work should be carburized at a furnace temperature of 100 deg. above the Ac range (1,700 deg. F.). A desirable compound will insure the development of the eutectoid range with traces of hyper-eutectoid structure.

Chipping of the case

Enfoliation is a condition where flasking, chipping, and often peeling of the case is noted. Microscopic and chemical investigations indicate definitely that this line or plane of weakness characterizes the separation of the hyper-eutectoid zone from that of the hypo-eutectoid. In order to avoid this condition, it is necessary that the temperature factor be controlled, insuring no excess of carbon being developed (hyper-eutectoid) beyond the traces previously mentioned. Hence, it would be unsafe to use temperatures over 1,700 to 1,725 deg. F.

It has also been pointed out in an article dealing with the heat treatment of spring steel which appeared in the February issue of the *Railway Mechanical Engineer,* that temperatures materially above the Ac 3 range cause an increase in the grain growth with decrease in toughness. This is indicated by the following table compiled by Guillet:

Temperature, deg. F.	Impact-test Kilograms-meters
1470	26
1560	28
1650	15
1740	12
1830	7
1920	3
2010	4

It is thus obvious that any heating over a protracted period at temperatures above the upper critical range (Ac 3) greatly lowers the resistance of steel to impact or shock.

Carburizing boxes

The selection or design of a box or container for carburizing should be given the utmost consideration. In the attempt to secure a uniform case much thought and research has been given to the selection of steel, carburizing agent, and the degree and duration of heating. All this, in many instances, has proved unavailing.

It must be remembered that the inside of a box requires considerable time to acquire the furnace temperature, and in a large box such as is used for valve motion parts, the material in the center lags behind the indicated furnace temperature several hours or its temperature equivalent of several hundred degrees. No manipulation of the furnace can change this effect. It can only be remedied by altering the dimensions of the box itself.

Here, then, lies one explanation of many failures of valve motion work. The box should not be larger than is absolutely necessary for motion work and should be narrower in at least one dimension than in the others so that the heat has a chance to penetrate quickly from at least two sides and reach all the contents at about the same time. The box should not be made too deep in proportion to the other dimensions, that that bushings and pins can be packed in the same box. The design of the box should follow the outline of the link in rectangular form, allowing approximately 3 in. on all sides for clearance and packing.

For railroad work, suitable boxes can be made from boiler plate, electrically welded or suitably riveted. Cast iron boxes are not satisfactory as their life is comparatively short. The cover should fit as close as is practical and legs should be provided to insure radiation of the heat from the bottom of the box.

Carefulness in packing is fundamental for good practice and uniformity of results, just as much as carefulness in heating or treatment. The method of packing should be such as will insure as nearly as possible the even heating and uniform carburizing of all parts of motion work in the same box. Heavy pieces such as links do not

require the same amount of care as the smaller pieces.

The first step in the general operation of packing is to cover the bottom of the box with compound to a depth of 1½ to 2 in. The link should then be placed firmly on the bed so that the compound and work are in close contact with each other. The bushings and pins should be placed at such points in the box as will prevent contact with each other or with the sides of the box and should be separated by at least 1½ or 2 in. of compound. An insufficient amount of compound will cause non-uniformity of results; a little too much is more advisable than too little.

The top layer should have at least 2 in. of compound sprinkled over it. When the box is fully packed, the cover is placed on the box and the edges carefully sealed with fire clay. The box is now ready for the heating operation.

Furnace design

There are a number of furnaces satisfactory for carburizing work but it is not the intention to recommend any particular make but to confine this discussion to the general design. Three main points are to be considered:

1—The furnace should have a capacity of attaining the maximum temperature necessary.

2—It must obtain a thoroughly uniform heat application at any of the intervening temperatures and be capable of maintaining that temperature with little or no variation.

3—The atmosphere in the furnace should be non-oxidizing so as to protect the box and work where reheating operations are performed.

Under-fired furnaces, developing indirect combustion, are most generally used and have proved very dependable.

Thermal temperature

Link motion work that has undergone the carburizing process previously described, requires a subsequent heat treatment. As one of the essential aims of carburizing valve motion work is to produce a hard abrasive surface, and as carburized links and parts, when slowly cooled from the carburizing temperature, are lacking in this quality, it is evident that a hardening process is necessary. Where the carburizing temperature has not exceeded 1,700 deg. F., the grain growth in the links and the pins is not of sufficient importance, in consideration of their cross section area, to warrant the expense of a double treatment. We will, therefore, confine our discussion to the heat treatment of the case. Bushings, due to their comparatively small cross section, should be double heat treated and will be discussed separately.

When the carburizing process is completed, the links should be allowed to cool in the box, then replaced in the furnace and heated about 1,450 to 1,500 deg. F., and quenched into running cold water if maximum results are desired. Owing to the design of the link itself and the necessity for having a hard abrasive surface in the slotted area, it is necessary that some means be provided to insure a constant flow of water within this area during the quenching operation. If the link is immersed into the quenching tank without this precaution, vapor pockets are invariably created, causing a slow radiation of heat, which in turn prevents the developing of Martensite or the hardening constituent of steel. Soft links, where complaints have led to investigation, in a great number of cases have been attributed to this one cause.

It has been a more or less common practice to quench the links direct from the carburizing temperature. Satisfactory hardness can be secured, but at the expense of the grain growth in the case, which has a marked tendency to cause chipping. If the consideration of chipping is not of serious importance, considerable time and expense can be eliminated by the direct quenching method and a satisfactory, serviceable link secured.

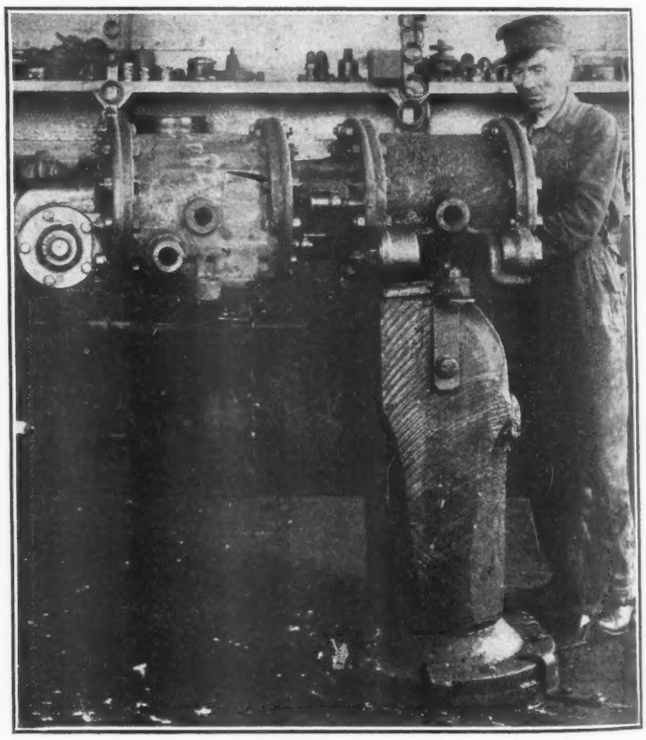
Pins may be processed in the same manner, provided failure of the pin is not indicated by fracture. If pins are rendered unserviceable from this cause, a double heat treatment will materially increase the fatigue resisting characteristics.

This double treatment is as follows: After carburizing, reheat the parts to 1,600 to 1,625 deg. F., quench in oil, and then reheat to 1,425 to 1,450 deg. F. and then quench in water. This treatment will develop the maximum physical characteristics possible. If abrasive value or hardness is the most necessary requisite, a direct quench from the carburizing temperature will serve.

Bushings at all times should be double heat treated as follows: After carburizing, reheat to 1,600 to 1,625 deg. F. and quench in oil; then reheat to 1,425 to 1,450 deg. F. and quench in water. This will insure a tough bushing with a maximum hardness and abrasive value.

Handy bench for repairing air pumps

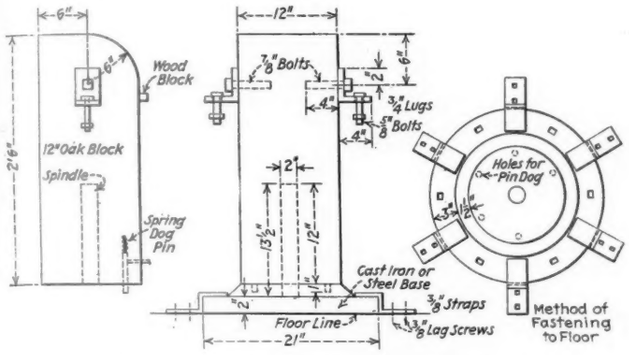
An improved type of bench for repairing air pumps is described in the June 15, 1924, issue of the Mechanical Department Bulletin of the Kansas City Southern. It was designed by Charles Mays of the Shreveport, La., shops. Formerly an ordinary repair bench was used for air pumps undergoing repairs, which made it somewhat inconvenient to perform the work. It also required the assistance of a helper to place the pump on the bench and get into a convenient position for the mechanic to work on.



An air pump bench that may be rotated to any position desired and which permits the mechanic to work underneath

In order to eliminate this difficulty the bench shown in the sketch has been devised. It consists essentially of an

oak block 12 in. square by 2 ft. 6 in. high which is pivoted on a cast iron or cast steel base. The base is secured to the floor by means of ⅜-in. lag screws. Brackets for holding the pumps are bolted to the block 6 in. down from the top by means of ⅞-in. bolts, and ⅝-in. bolts are used to secure the lugs of the air pump to the brackets,



Sketch of bench for repairing air pumps

as shown in the illustration. The pump may be swung down to a vertical position from the horizontal position shown.

Pumps are placed on the bench by means of an air hoist. A saving of nearly 25 per cent over the former method has been accomplished by the use of this bench for repairing air pumps.

Welding locomotive frames with bronze

By J. H. Chancey
Blacksmith foreman, Georgia Railroad, Augusta, Ga.

SEVERAL inquiries have been made by those interested in the subject of bronze welding for locomotive frames. Inasmuch as there are now on the Georgia Railroad, nine frames welded by the Tobin bronze acetylene process, which have been in continuous freight and passenger service from three to nine months, our experience may be of value.

When the subject of welding frames with the bronze method was first suggested by a demonstrator, the writer was reluctant to attempt it. However, after being assured that it was possible to weld the bronze to steel or iron so that the bronze would break before tearing loose at its welded surface, this method of welding locomotive frames began on the Georgia Railroad.

In relating our experience to a number of persons, such a lack of confidence and disapproval was manifested that it was decided to test the process out in our own way, and so authority was given for the tests to be made. The results of these tests are given below.

Test No. 1—Two pieces of Tennessee bloom iron, 4¼ in. by 4¼ in. by 12 in. long, were welded together by the acetylene process, using ¼-in. Tobin Bronze filler. This test piece was then placed in a wheel press in such a position as to allow the press ram to bear directly against the center of the weld. The test piece started bending at 75 tons pressure and bent 2 in. out of center at 100 tons pressure. The pressure was released at 100 tons and the test piece was reversed and the pressure reapplied. It started bending at approximately 100 tons, bent 1¾ in. out of line and cracked one-half way through the center of the weld at 125 tons pressure.

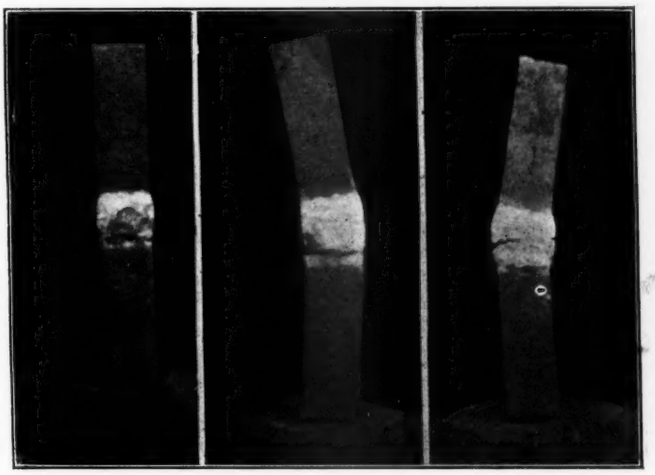
Test No. 2—Two pieces of material of the same grade and of the same dimensions were welded by the acetylene process with ¼-in. Norway iron filler. The piece was tested in the same manner and it started bending at approximately 70 tons pressure and bent 2 in. out of line at 100 tons. The pressure was released at 100 tons, and on the reverse pressure it started bending at 95 tons; bent 1½ in. out of line and cracked one-half way through the center of the weld at 110 tons pressure.

Test No. 3—Two pieces of material of the same grade and of the same dimensions were welded by the acetylene process with No. 1 patented steel ¼-in. filler. Using the same method of testing, the piece started bending at approximately 80 tons pressure, bent 1½ in. out of center and broke entirely through the center of the weld at 100 tons pressure.

Test No. 4—Two pieces of the same grade and of the same dimensions were welded by the electric process with 3/16-in. filler and when tested, started bending at 85 tons pressure, bent 1¼ in. out of line and broke in two pieces at 100 tons pressure.

From these tests the reader will note that the bronze weld surpassed all others by a margin of 15 tons, and the writer is thoroughly convinced that the bronze weld for locomotive frames is superior to autogenous welds with any other material he has thus far used.

In making these test welds, full access was afforded for



The results of testing a Tobin bronze weld

the testing of expansion and contraction, and it was found that the bronze weld contracted only 3/64-in. after entirely cooling off. Therefore, the bronze weld eliminates the frame problems we are confronted with, where it is almost out of the question to get the required expansion, other than by electric welding. Still another feature in favor of the bronze weld is that it can be completed in approximately one-half the time required in using any other filler, which necessarily results in quite a saving.

The following precautions should be taken when making a bronze weld. Cut the vee to a sufficient angle to give the necessary torch play, taking pains, of course, not to get it too large. Use as small a vee as possible so as to obtain a quicker, better job with less expense for material, labor, etc. Chip the welding surface of the frame as clean as possible, and last, but not least, get the best obtainable operators on the job.

On October 15, 1924, we welded a 4-in. by 5-in. top rail in front of a main driver without removing any parts and also allowed for no expansion. This job was completed in 30 min. after the torch was applied, using No. 10 tips. The entire cost of this operation, including labor and material, amounted to approximately ten dollars.

Repairing driving boxes in the average size shop*

By H. H. Henson
Machine shop foreman, Southern, Chattanooga, Tenn.

THIS is the most important key job in the railway locomotive shop. All of the different parts are usually ready to be assembled on the locomotive except the driving boxes. The machinist cannot lay off the shoes and wedges until he gets the driving box sizes. After the driving boxes are ready for the locomotive, everything moves along rapidly. Every machine shop foreman has some different idea of performing the different operations involved in this work. Some still cling to the old method of many years back.

The shop in which the writer is employed is not the largest on the system, but probably our method of handling driving boxes, may be of interest to some foremen in locomotive shops of a similar size. The practice adhered to in this shop is to keep one full set of driving boxes machined all over, ready to be bored for each class of locomotive which we have, besides extra boxes for the drop-pit repairs. This method insures a full set of boxes for the engine that is first due out of the shop. Boxes are always on hand ready to bore as soon as the wheels are dropped on locomotives in for light repairs.

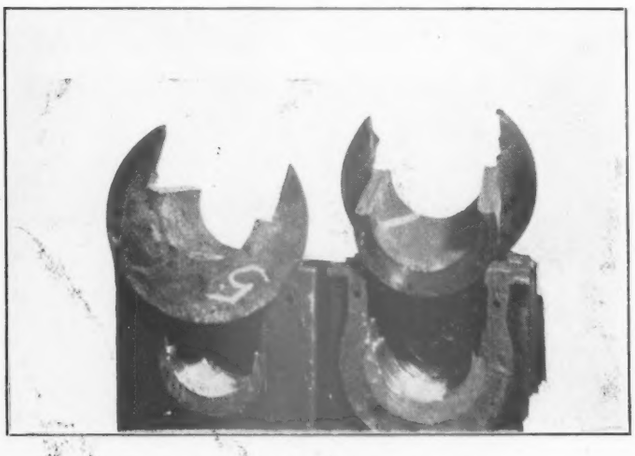


Fig. 1—Flanged driving box brasses

As soon as the locomotives in the erecting shop are stripped, all boxes are cleaned with oil and waste or sent to the lye vat. After passing through the cleaning process repair work is started at once on the set of boxes so as to have them ready for the next locomotive of that same class. The boxes are first examined to see if any have to be replaced on account of defects. The lead man of the box gang checks up the box sizes to see if any are undersize, and if he finds any, a record is taken after which they are sent to the electric welder to have slabs welded on, thus building the box up to conform to the standard size.

Method of applying brasses

Instead of pouring on the brass hub liner into the counterbore of box, as is done in some railroad shops, a brass is used that has the flange or hub liner cast in one piece which gives much better satisfaction than the old type. The driving box is prepared for this brass by counterboring the hub side of the box ⅜ in. deep, and making the diameter to suit the size of the box. These brasses are very easily handled, as they require no special chuck or mandrel to machine them. They are machined on a 36-in. Niles heavy duty engine lathe. The lathe hand can turn the brasses to fit the crown in the driving box, as fast as the shaper hand can lay off and machine the sides of the brass preparatory to pressing them in the box. Fig. 1 shows one of the flanged type brasses in the rough casting, ready to be machined. This is done by placing only the flanged section in the ordinary lathe chuck.

After the brass has been machined and pressed in the driving box, it is then ready to have the shoe and wedge sides faced on the planer in the usual way. After the planing operation, there is drilled in the top or crown of the box and brass a hole, 1¼ in. or larger, depending upon the size of the driving box. This hole is then reamed with a taper reamer from the inside of the box, and a taper brass pin driven in with a sledge hammer. Oil holes are drilled through the face of the hub on the box into the oil cellars in the top of the driving box, to lubricate the hub-liner.

The boxes are now ready for the vertical boring mill.

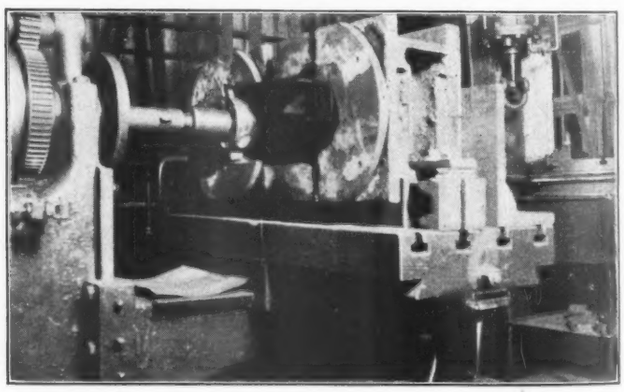


Fig. 2—Method of boring driving boxes in a horizontal boring machine

on which the hub sides of the flanges are faced to the required thickness for the lateral motion between the wheel centers and the hub sides of the boxes. The boxes are held on the boring mill table by means of a two-jaw universal chuck. The boxes are then taken to the heavy duty Niles horizontal boring mill to be set up, and bored as in Fig. 2. It will be noted that an expanding double-cutter boring tool is used which bores the box in 30 to 45 minutes, depending on the size of the journal. Only two cuts are taken, a roughing and finishing cut. The cutters are made of high speed steel, ½ in. by 1½ in. in size and lengths to suit. Two boxes are set up on the mill to start with. They are laid off by the lead man of the driving box gang, and when one box is completed the

*One of the papers presented in the driving box competition which closed April 1, 1924.

boring mill man shifts the table over to the other and begins boring. While the heavy roughing cut is being taken, he hoists up another box and fastens it to the table. This keeps the tool almost continually busy.

Manner in which the boxes are bored

The front, intermediate, and back boxes are bored 1/32-in. larger than the journal while the main boxes are bored to a snug running fit. The front, intermediate and back boxes have a recess cut in the crown of the brass, as shown in Fig. 3, and are also undercut 1/32-in. deep, and about 1 in. back from the edge of the fillet, or shoulder at point *A*. Grease or journal compound grooves are cut 3/16-in. deep, by 3/16-in. wide, extending from the undercut edge of the brass to the recess

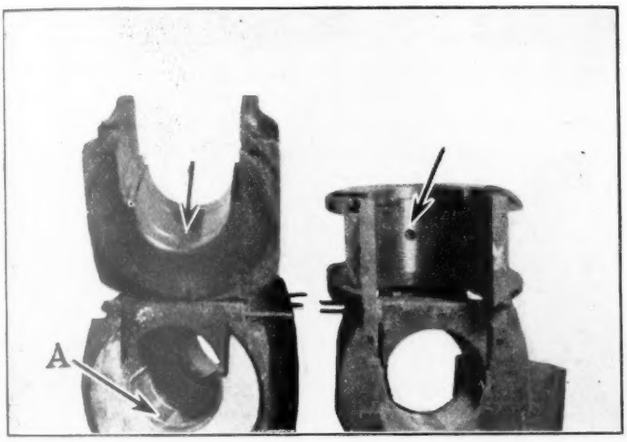


Fig. 3—Arrows indicate the location of the recesses in the driving box brass—Point A shows the location of the undercut

in the crown of the brass. This is to give the journal compound a good starting place to feed through, or circulate around the journal, as new brasses must have plenty of lubricant to start with in order to obtain the proper amount of mileage from the locomotive before it has to have its brasses recrowned or renewed. It is safe to say that 50 per cent of the success with journals regarding pounds and mileage, is due to the quality of the brass that is used in the box. It is very essential that driving box brasses should be cast of the very best material.

The machining of the main driving box requires just a little different operation at point *A*, Fig. 3. The brass is undercut 1/32-in. deep, and only ⅜ in. back of the fillet, instead of 1 in., as in the other boxes. The purpose for this difference is to have a snug job on the main boxes, as they pound soon enough. On the switch engines, the grease grooves are cut entirely around the bore of the brass because they back up as much as they go ahead. The Franklin No. 4 lubricator is used on switch engines with ⅜-in. perforations in the grease cellar as this type of locomotive never moves fast enough to warm the journal compound so that it will feed freely. On freight and passenger locomotives the Franklin No. 4 lubricator is used also, but it has 3/16-in. perforated cellars, instead of the ⅜-in. size.

Cutting the compound grooves on freight and passenger locomotives differs somewhat from the practice for switch engines. They are cut 3/16-in. wide, but only one groove is cut in the brass on the shoe side, and two on the wedge side. The reason for this is that road engines move ahead much more than they move backwards.

Fig. 4 shows the method employed for machining the circle on the rough box preparatory to fitting the brass. Four of the average size boxes or two of the heavy Mountain and Santa Fe type locomotive boxes are set up at one time on the table of a Morton draw cut shaper.

The hub liner problem looms up at this point of the article for its criticism. Many schemes have been tried and found wanting. Even Henry Ford is experimenting along this line, by testing hub liners of steel, case-hardened and ground, on Detroit, Toledo & Ironton locomotives. Of course, every mechanical supervisor has tried some kind of a hub liner, and when it is all summed up, they all get about the same results. The hub liners used at this point are made from steel boiler plate, electrically welded to the driving wheel center or hub. This method is inexpensive, and requires very little machine work, as the liners are laid off on sheet metal in circles to within ¼ in. of size, cut out with the acetylene torch, turned on the outside diameter and bored, separated in only one place, heated on the side opposite to the cut, applied to the journal, and then welded to the wheel center.

Other factors to consider

Good machine tools are among the most important factors in obtaining efficiency and production in a locomotive shop. The foreman comes in at this point for a little criticism. He has to be a "live wire," a good leader and instructor, and also must have the confidence of his men, to get the best results. The only way to gain the

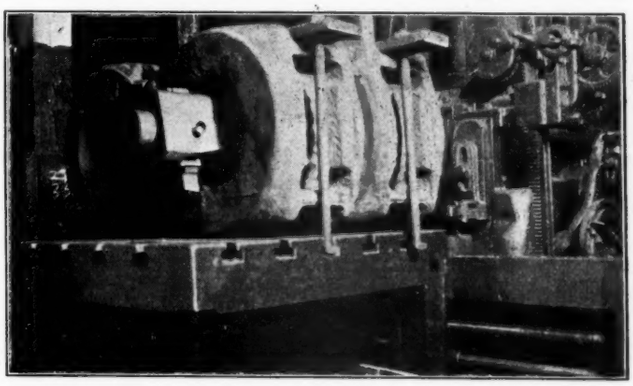


Fig. 4—Method of machining circles on the rough box preparatory to fitting the brass

confidence of his men is to show that he is a first-class mechanic and up-to-date in his methods.

The tool room should not be neglected, as it makes for efficiency and production when it furnishes the proper tools and fixtures to work with. When you have machine tools that cannot produce, change them so they will give the desired results. When a machine tool will drive all the high speed tool bits will stand, then it is certain that the machine is giving production.

THE CARS in use by the British railways have always been very diminutive from an American standpoint, and now that the 120-ton coal car is coming into use on this continent, so at least one British road is adopting larger cars for its coal traffic. The road is the Great Western, and the new cars which it has placed in service are of 20 long tons' capacity, replacing cars of 8, 10 and 12 long tons. Apparently the chief obstacle in the way of adopting larger cars in England, aside from the severe limitations of clearance, is the habit and equipment of the shippers. Shippers equipped to handle 12-ton cars may find changes in methods and perhaps additional capital expenditures necessary in order to utilize the larger cars. Therefore, in order to offer some inducement to shippers, the railway is offering a 5 per cent rebate to all shippers using the larger cars loaded to capacity.

Portable tool box for valve motion mechanics

THERE can be found in railroad shops many types of portable tool boxes but the one shown in the illustration and used at the Billerica shops of the Boston & Maine has its own unique advantages. This tool box is particularly designed to meet the requirements of the mechanic who sets and squares up valve motion.

For this specialized job the mechanic must have a certain set of tools among which are such items as, trams, scribers, dividers, etc., which must be properly taken care of. This he can readily do by placing them under lock and key in the box shown. At the end of his day's work

Combination portable tool box, material wagon and ladder for locomotive mechanics

he can leave the box set wherever he may be in the shop and come back in the morning and find it there with the tools intact.

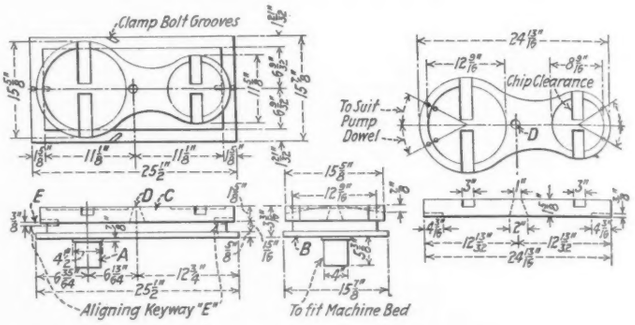
It will be noticed that the box covers only half of the top of the wheel-barrow. The remaining part is used to haul valve motion parts to the locomotive and is also convenient for the machinist to stand on so that he can readily reach the highest point of the valve motion.

Boring jig for air pump cylinders

STEAM and air cylinders can be bored complete in 10 min. on a Bullard vertical turret lathe or boring mill by using the jig here illustrated. The jig is placed on the bed of the boring mill with the lug *A* fitted into the center hole of the bed. It is then secured to the bed by bolts which enter the bolt grooves on the bottom plate *B* of the jig shown in the sketch. This completes all the work necessary to align the air pump cylinders to the boring spindle or tool. Both the top and bottom plates have dowel holes drilled at different radii so as to fit the dowels on different sized pumps.

The pump is placed on the jig, either end up, with the dowel pins on the cylinders inserted in the dowel holes. This places the center line of one cylinder equidistant from the boring bar and it is then ready for boring.

After one cylinder has been bored, the keys *E* are pulled out, which allows the pump and top plate *C* to turn on the pin *D*, bringing the other cylinder into position for boring. The keys *E* are then replaced in the keyways and the job is completed. Pump cylinders have been refinished on this jig, placed on an old boring mill, quicker than on machines built especially to do the work. Grinding a badly worn pump cylinder usually takes from one to three hours, but it has been found that much time



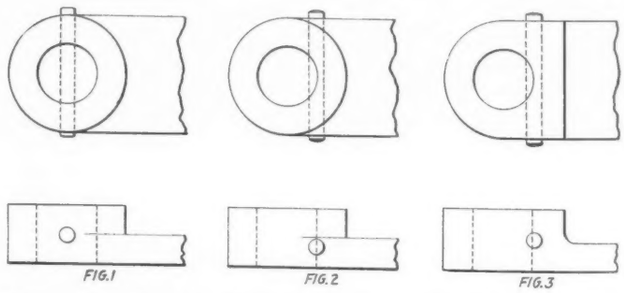
Jig for holding steam and air pump cylinders on a Bullard vertical turret lathe

can be saved if the pump cylinders are rough bored by the use of this jig and then ground.

This jig was designed by W. L. Lauer, general foreman, Illinois Central, Memphis, Tenn.

Securing small hubs or levers to shafts

CERTAIN minor locomotive parts such as bell yoke bearing shafts, cylinder cock levers and stoker mechanisms, in common with numerous machine parts not from locomotives, are positioned and secured by a taper pin or rivet as shown in Fig. 1 of the sketch. This method has the advantage of being simple and requiring a minimum of time in completing the assembly of the parts, but often causes trouble owing to the tendency of



The additional metal allowed by the arrangement shown in the last two figures tends to eliminate breakage

the pin or rivet to shear or occasionally the shaft to break on account of its reduced cross section.

The same size pin applied through the side of the shaft as shown in Fig. 2 presents a greater cross section to either a rotating or end movement of the shaft. Another advantage is that the work cannot be assembled with the shaft a half turn from its proper position as sometimes happens when the pin is located as in Fig. 1. As the parts thus assembled are not usually intended to be interchangeable with similar parts, no disadvantage occurs due to the changed position of the pin.

If the hub is forged or cast as in Fig. 3 the additional metal serves to reinforce the pin bearing and lessens the chances of hub breakage which exists in Fig. 1.

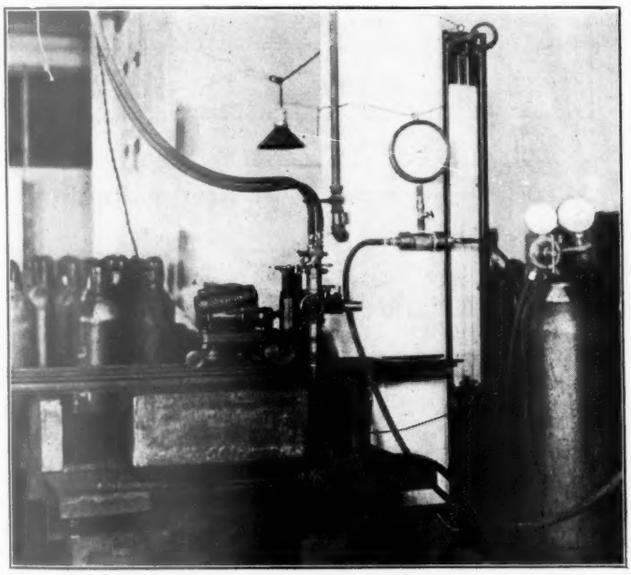
Economies effected by the use of high purity oxygen*

Consumption of the gas and the cutting time substantially reduced—Drag of cut improved

By John J. Crowe † and George L. Walker ‡

UNTIL a comparatively recent date, all oxygen was produced by chemical or electro-chemical means, and some of the older users of oxyacetylene torches will tell you that the oxygen produced for welding and cutting was very expensive and that it was about as impure as it was expensive when judged by our present standards. Today most of the oxygen used in oxyacetylene welding and cutting is manufactured by the liquid air process.

The atmospheric air is liquified by compressing and



Radiograph controlled cutting torch

cooling, and the oxygen is obtained by what amounts to a distillation process. The boiling temperature of oxygen at atmospheric pressure being —296.5 deg. F., whereas the boiling point of nitrogen is approximately 24 deg. F. lower or —320.8 deg. F.

The discovery of the principle of the oxyacetylene torch was first announced by the famous French physicist Henri LeChatelier in 1895 in a paper read before the Academie de Sciences, on the temperatures of flames. He stated at that time that the temperature of the oxyacetylene flame was 1,000 deg. C. higher than the oxyhydrogen flame, and we know today that the temperature approximately 3,480 deg. C. (6,300 deg. F.) exceeds that of any other know flame and closely approaches the temperature of the carbon arc. Practice application was made of the principle of the oxyacetylene flame by Fouché and Picard when they developed the first oxyacetylene torch in 1901.

The first torches were for welding, but it was not long before application was made of the principle of iron and steel combustion in an atmosphere rich in oxygen when raised to their ignition temperatures.

Oxygen purity

Until quite recently oxygen users were contented with oxygen of 97 to 98.5 per cent purity, but today, at least in the United States, such is not the case. By improving the apparatus and operation of liquid air plants it has been found possible to manufacture, commercially, oxygen of much higher purity. By stages the purity of oxygen has been increased until now it is possible to obtain, continuously by that method, oxygen with a guaranteed purity of 99.5 per cent, plus or minus a tolerance of 0.1 per cent.

The question naturally arises, what benefits are to be derived from small increments in purity as we approach the ultimate limit of 100 per cent oxygen. To answer this question the Air Reduction Sales Company has car-

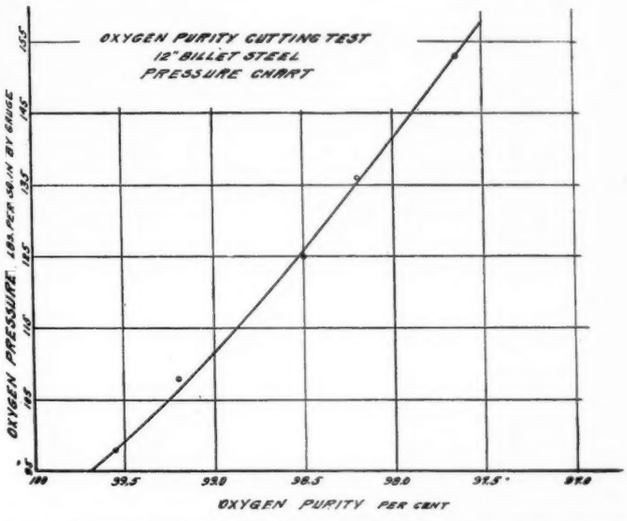


Fig. 1—Pressure chart which shows how the pressure increases as the purity of the oxygen decreases

ried out two series of experiments extending over a period of several years, and it is the results of these experiments which are presented in this paper.

Method of making tests

The experiments were made on steel plates and rolled steel billets, ranging in thickness from ⅜ in. to 12 in. To eliminate the human element or personal equation as far as possible, all the cutting done in the first series was done with a hand torch mounted on a radiograph geared

*Abstract of a paper presented at the February 16 meeting of the American Welding Society, New York City. Copyright, 1925, by the Air Reduction Sales Company, New York.

†Engineer in charge of the apparatus research and development department, Air Reduction Sales Company.

‡Associate engineer of the apparatus research and development department, Air Reduction Sales Company.

to give variable speeds from a few inches per minute up to 60 in. or more per min., and in the second test series the cutting was done with a machine torch mounted in the same manner.

The speed of the radiograph was checked with a stop watch. The pressure, where practicable, were measured with mercury manometers, and the higher pressures were measured with standard test gages, frequently calibrated and tested on a dead weight gage tester. The gas (oxygen and acetylene) consumptions were obtained by weighing the cylinders before and after using, on scales accurate to ¼ ounce, and these weights were checked up making up the loss in weight with shot and then weighing the shot on a separate balance. All the material was

Table I—Oxygen consumption of various purities required to cut metals of various thicknesses, using 100 cu. ft. of 99.5 per cent oxygen as a basis of comparison.

Thickness of metal, in.	Series No.	Oxygen purity 99.5 per cent	99.0 per cent	98.5 per cent	98.0 per cent	97.5 per cent
⅜	1	100.0	114.1	125.5	.....	.....
½	1	100.0	111.1	121.5	.....	.....
¾	1	100.0	116.0	140.0	.....	.....
1	1	100.0	115.4	135.0	.....	.....
2⅛	1	100.0	108.0	123.4	.....	.....
2⅞	2	100.0	112.1	127.5	148.8	173.9
4⅜	1	100.0	113.3	141.5	.....	.....
6	1	100.0	108.8	133.6	.....	.....
6	2	100.0	114.8	131.7	150.1	169.3
12	1	100.0	108.4	119.5	.....	.....
12	2	100.0	108.9	122.0	139.0	161.0
Average consumption		100.0	111.9	129.2	145.9	168.1
Difference for each ½ per cent decrease in oxygen purity.....			11.9	17.3	16.7	21.5

cooled to approximately the same temperature before cutting, and the experiments were carried out under laboratory conditions in which every possible variable was controlled as closely as possible.

The laboratory was furnished with an ample supply of oxygen varying in purity from 98.5 per cent to 99.5 per cent by steps of approximately ¼ per cent for the first series and from 97.5 per cent to 99.5 per cent by ½ per cent steps for the second series. The actual purities were determined at the time of manufacture, and were carefully checked in the laboratory.

Previous experiments in which oxygen of various purities manufactured by the electrolytic process compared with oxygen of the same purities manufactured by the liquid air process had shown no measurable difference.

Results of the tests

In the typical graph shown in Fig. 1 the minimum pressures required to cut a 12-in. billet have been plotted against the purity of the oxygen used. To determine these pressures a large number of preliminary cuts were made on each thickness of metal with oxygen of each purity. The method of procedure followed was to start with a pressure that would make the cut without difficulty, and then to reduce the pressure by stages until the minimum pressure was found that would just make the cut.

Preliminary experiments were also made to determine the most economical size of tip and the speeds to use in making the final cuts. The curve shown is concave upwards but only slightly so, and this is typical of all curves plotted in this manner.

Taking Fig. 1 as an example it will be noted that the pressure required to cut a billet 12 in. thick using oxygen of 99.5 per cent purity was 99 lb. per sq. in., whereas it required a pressure of 112 lb. when the oxygen purity was reduced 0.5 per cent and if the purity was dropped to 98.0 per cent the pressure required was increased to 142 lb.

As the cutting tip was the same for all cuts on the same thickness of metal the oxygen consumption for the same amount of cutting increases with the pressure required to make the cut.

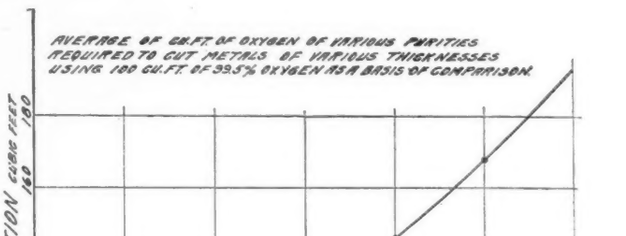


Fig. 2—Graphic presentation of the mean results given in Table I

In order that the data obtained may be more easily compared they have been tabulated in Table I after reducing to a common basis, that is, the number of cubic feet of oxygen of the various purities required to cut metals of the various thicknesses, using 100 cu. ft. of 99.5 per cent oxygen as a standard of comparison. The mean of the results given in the table is shown graphically in Fig. 2.

It will be noted that 11.9 per cent more oxygen of 99.0 per cent purity is required to do the same amount of cutting as was done with oxygen of 99.5 per cent purity, and

Table II—Actual time required to make cuts of given lengths of metals of various thicknesses using oxygen of various purities and time expressed in percentages using time required with oxygen of 99.5 per cent purity as a standard.

Thickness of metal, in.	Oxygen purity 99.50 per cent: Time to make cut, min.	sec.	Per cent	99.25 per cent: Time to make cut, min.	sec.	Per cent	99.00 per cent: Time to make cut, min.	sec.	Per cent	98.75 per cent: Time to make cut, min.	sec.	Per cent	98.50 per cent: Time to make cut, min.	sec.	Per cent
⅜	74	18	100	79	51	107.3	84	45	114.0	91	30	123.1	93	24	125.5
½	42	15	100	43	13	102.3	46	54	111.0	48	42	115.2	51	15	121.3
¾	35	45	100	38	3	106.4	41	27	115.9	48	48	122.5	50	5	140.1
1	35	20	100	37	18	105.6	40	45	115.3	43	0	121.7	47	39	135.0
2⅛	26	7	100	27	4	103.7	28	12	105.0	29	40	113.7	32	14	123.5
4⅜	14	29	100	15	25	106.5	16	25	113.4	18	32	128.0	20	27	141.3
Mean			100			105.3			112.9			120.7			131.0
Difference for ¼ per cent in oxygen purity						5.3 per cent			7.6 per cent			7.8 per cent			10.3 per cent
Difference for ½ per cent in oxygen purity						12.9 per cent						18.1 per cent			

when the oxygen purity was dropped from 99.5 per cent to 98.5 per cent the increase in consumption was 29.2 per cent. In other words, it required 129.2 cu. ft. of 98.5 per cent oxygen to make the same length of cut as was made with 100 cu. ft. of oxygen having a purity of 99.5 per cent.

The preceding data have shown how the oxygen consumption increases with a decrease in oxygen purity without reference to time. The results of time studies made in the first series of experiments on sizes up to 4⅜ in. thick are given in Table II. Owing to the large amount of material involved, these experiments were not extended to cover the larger sizes, all the cutting on the 6-in. and 12-in.

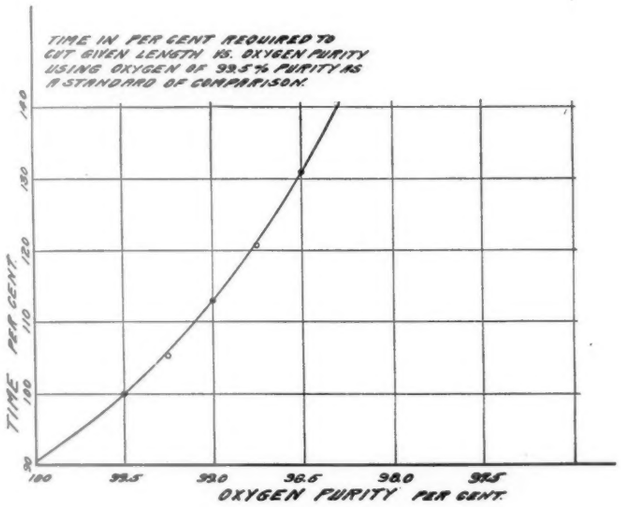


Fig. 3—Graphic presentation of the data given in Table II

billets being made at constant speed. The actual time to make the various cuts is shown in Table II and in order to compare the results they have all been reduced to a common basis and expressed in percentages using the time obtained with 99.5 per cent purity oxygen as a standard of comparison.

The loss in time expressed in percentages very closely approximates the waste in oxygen as the purity decreases, and the two go together, that is, as the oxygen purity decreases the time required to make a given cut goes up as shown in Table II, and the consumption of oxygen in making the cut goes up at the same time as shown in Table I. The average of the results expressed in percentages as shown in Table II is shown graphically in Fig. 3.

How pure oxygen effects drag

The characteristic drags obtained on the 12-in. billets with oxygen of four different purities are given in Fig. 4. For some work, such as straight line cutting, the amount of drag may not be of serious consequence but in the machine cutting of intricate shapes the drag must be maintained at a minimum as otherwise the underside of the shape cut will not register with the top side.

To decrease the drag to correspond with that obtained with the high purity oxygen (99.5 per cent) it would be necessary to increase greatly the pressures and it follows that the consumptions for the lower purities would be much greater than those shown in the curves and tables.

It was not the purpose of this investigation to enter into any considerable number of practical applications in cutting with high purity oxygen and the results obtained, but anyone interested can easily demonstrate the superior cutting properties of high purity oxygen by making simple and practical tests, if they will obtain oxygen of, say, 99.5 per cent purity and oxygen of 99.0 per cent purity or less and make cuts in the same steel plate or forging with both oxygens.

As a field check on the investigation made in the laboratory, a large number of oxygen cylinders analyzing 99.5 per cent and an equal number of oxygen cylinders analyzing 99.0 per cent were used for wrecking steel cars, and a careful study was made of the results obtained with the two oxygen purities. Ten cars were scrapped with each purity of oxygen, and to eliminate as far as possible the personal equation the operators were frequently changed from one oxygen purity to the other, and at no time were the operators informed as to the purity of the oxygen supplied them. Weather conditions were bad, the temperatures ranging from —30 deg. F. to —21 deg. F. and the cars were covered with snow. Working under these conditions and with operators some of whom had only a limited experience in oxyacetylene cutting, a saving of 10 per cent was shown in oxygen consumption and 11.2 per cent saving in time, both in favor of the oxygen having a purity of 99.5 per cent.

The following conclusions may now be arrived at.

First.—That small increases in oxygen purity greatly

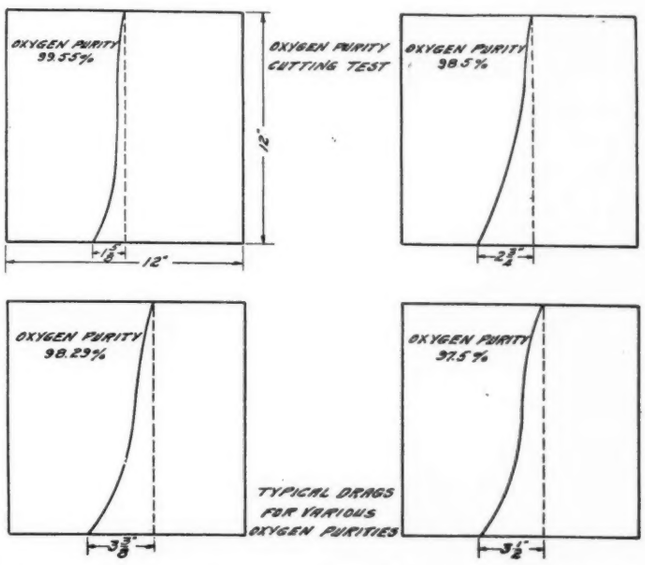


Fig. 4—Characteristic drags obtained on 12-in. billets with oxygen of four different purities

increase the efficiency of cutting operations, both as measured by oxygen consumption and by time required to complete a given amount of cutting.

Second.—That the difference of effect of small increases in oxygen purity decreases as 100 per cent purity is approached, but the effect is of considerable magnitude for the interval of 99.0 per cent to 99.5 per cent oxygen purity showing a saving of approximately 12 per cent for oxygen consumption and an equivalent saving in time.

Third.—That decreases in consumption and time with small increases in oxygen purity found by the laboratory have been substantiated by practical applications made with oxygen of 99.5 per cent and 99.0 per cent purity.

THE SHOPS of the Pennsylvania Railroad at Sunbury, Pa., according to report, are soon to be closed. These shops, employing about 500 men, have been in operation since 1876. Reports say that the skilled workmen will be employed by the road at other places. The Sunbury shops are not equipped for repairing modern large locomotives.

A handy tool rack for the boiler shop

By Joseph Smith

PROVIDING the proper means for storing and distributing tools is quite as essential as having sufficient tools. Fig. 1 shows the elevation of a tool rack with a central shaft 2¾ in. in diameter in three sections, turned down and bored out as shown at *E* and

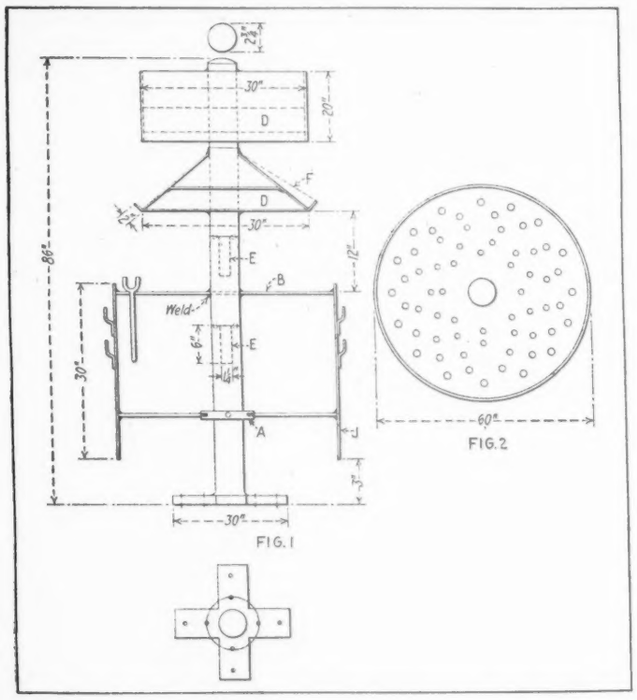


FIG. 1

FIG. 2

A boiler shop tool rack with two separately revolving containers

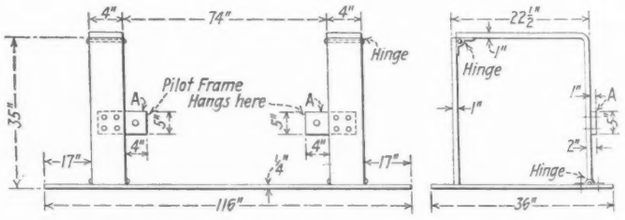
recessed as shown for ½-in. ball thrust bearings. The circular shell *J* is 60 in. in diameter and is made of ⅛-in. steel plate. The head, *B*, is constructed of ¼-in. steel plate welded to the shell *J* just a little below the top edge. The head, as shown in Fig. 2, has holes burned in at random to accommodate single ended wrenches, socket wrenches and various other tools. The brackets on the side of the shell are for double-ended box wrenches and similar tools. *A* is a wrought iron collar, bored for an easy fit around the shaft, and drilled and tapped out for four ⅞-in. rods. These rods are adjusted to the inside diameter of the shell and welded as shown, to support the bottom of the shell.

Front and end views of two shelves, made of ⅛-in. steel plate, are shown at the top of the drawing. These shelves are welded, as shown at *D*, and are used for storing small tools. They are made in one piece with a hole cut at the top to slip down over the shaft. The shelves are constructed with a 2-in. flange along the bottom edge to prevent the tools from sliding off. A taper flange is also welded on at each end, as shown by the dotted line *F*. These shelves may be used for staybolt taps, spindle taps and reamers.

The base is fastened to the floor by wood screws and is made of 4-in. by 1-in. flat iron. One piece is offset to fit over the other and both pieces are bored to fit the bottom of the shaft and welded. In assembling the shaft, a liberal supply of lubricant should be applied in the bore and at the ball bearings. An attendant can reach any tool by simply turning the rack.

Jig for holding steel pilot frames when riveting

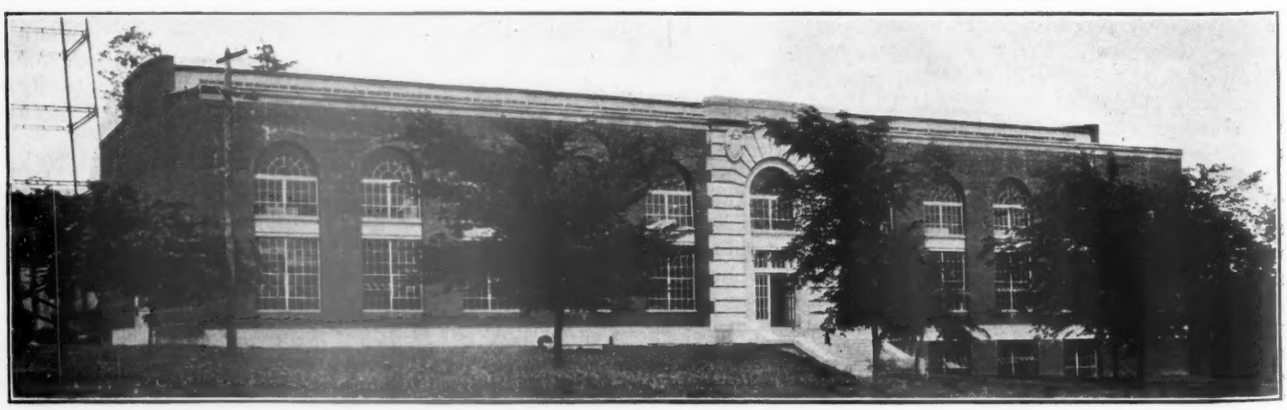
THE method of riveting together steel pilots as they rest on the floor always causes more or less trouble and inconvenience owing to the difficulty of placing them in different positions in order to rivet the various frame members. The difficulty was overcome by designing a jig, at the Grand Rapids, Mich., shops of the Pere Marquette, which swings on hinges enabling



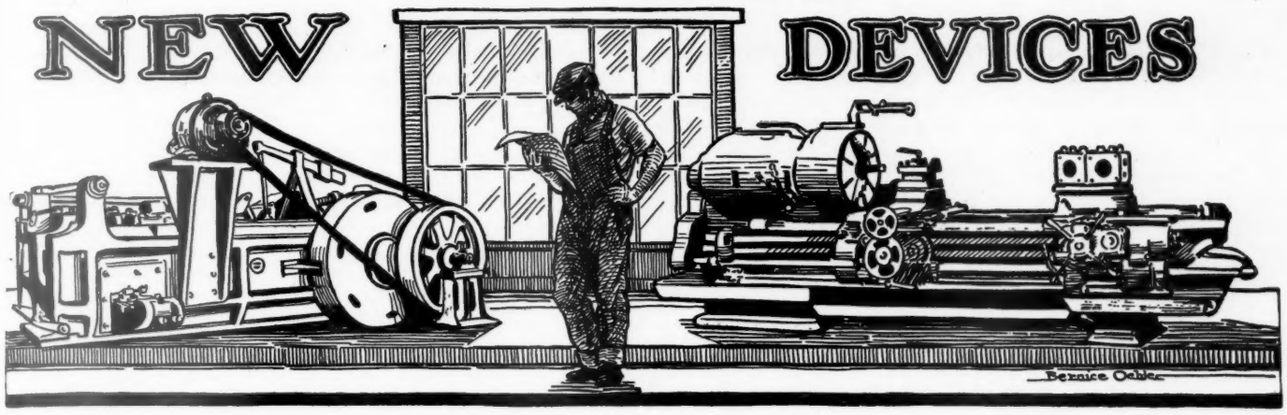
A pilot frame jig which swings on hinges

the workmen to place it in any position he may desire.

Referring to the illustration, the pilot frame is bolted to the lugs *A* thus holding it in the proper position for riveting. The hinges of the jig allow the pilot to be swung to all workable positions with very little effort, and a considerable saving of time.

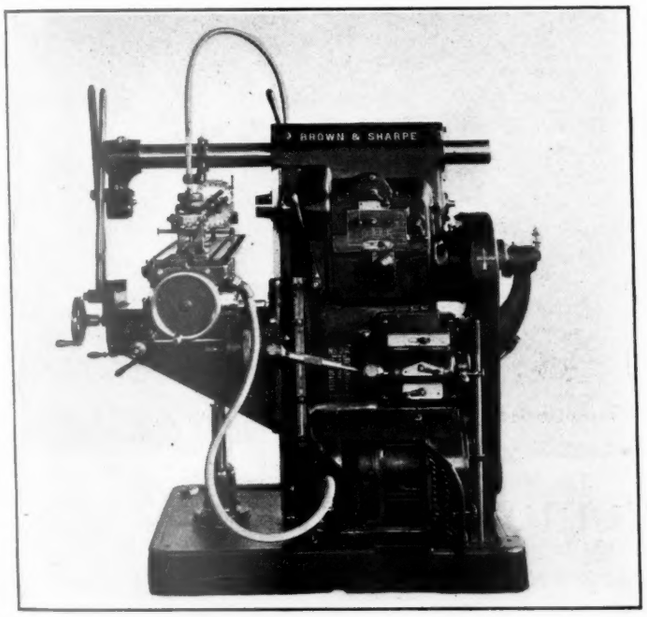


The mechanical engineering laboratory of The Pennsylvania State College



Milling machine with the motor in the base

A MILLING machine designed so that the motor is incorporated in the base has been placed on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I. These machines, when equipped with a motor, are entirely self-contained, the motor being enclosed in an oil-tight compartment in the base.



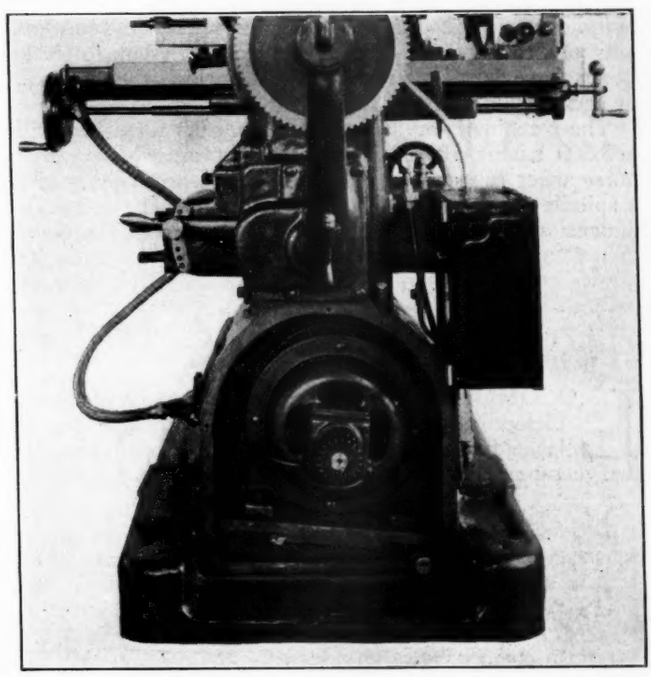
View of the right side showing the oiling arrangement for the motor bearings

The new design does not differ materially from the column and knee type except to include the construction necessary for this style of drive. The important change comprises a redesign of the lower part of the column to provide for the motor compartment which is cast with a solid top as a part of the column. Complete protection is furnished the motor from oil, cutting lubricant, chips and dirt. A tank for the cutting lubricant is located in the base, extending around the foot of the elevating screw. Strainers set in the top of the base provide for the prompt return of all oil to the reservoir.

Ample provisions have been made to insure a sufficient circulation of air by three ventilators located on the sides and rear of the compartment. They serve a two-fold purpose in that they also permit ready access to the motor for purposes of lubrication, repairs, adjustment and cleaning.

Oil wells fastened to the frame of the motor and readily accessible through the door on the right of the machine, are connected by tubes to the motor bearings. This permits quick and positive lubrication of these parts.

In order to facilitate installing and removing the motor and to provide for adjustment of the driving chain, a separate adjustable base is provided on which the motor is mounted. This base is hinged on the right side and has an angular adjustment regulated by means of the bolt on the left of the column outside the compartment. The bed of the motor is tongued and slides into a groove in the hinged base. When in position, the motor is held firmly in place by a gib inserted in the motor ways. The



Rear view with chains and guards removed, showing interior of the motor compartment

driven and driving sprockets as well as the driving chain are fully enclosed by a cast iron guard.

A distinctive feature of the machines is the ease with which the friction driving clutch can be adjusted. This clutch is mounted within the driving pulley or sprocket, on the main drive shaft. By removing the small plate on the side of the pulley, through an opening in the chain guard, the clutch can be readily adjusted without any further dismantling of the machine.

All parts of the machine are conveniently located for purposes of adjustment and operation. Complete access to the motor compartment is obtained by removing the chain guard, the chain and rear wall of the compartment.

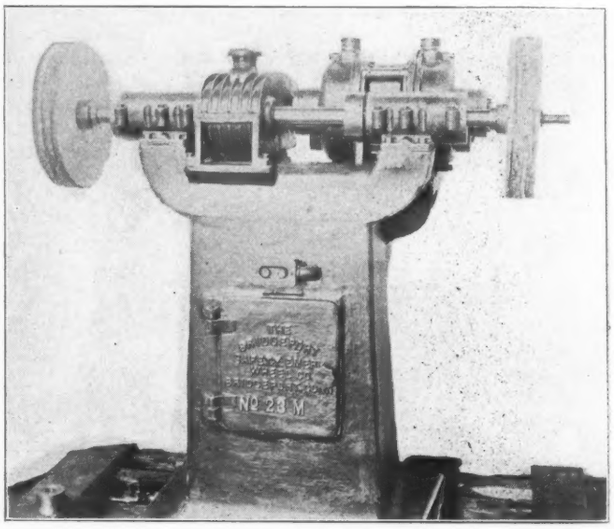
When used as a belt-driven machine the motor compartment is available for storage of tools and parts. The change from belt to motor drive can be easily and quickly accomplished. These machines are made in two styles of three sizes each; the Nos. 1A, 2A and 3A universal and the Nos. 1B, 2B and 3B plain milling machines.

Buffing lathe with chain drive

CONSIDERABLE difficulty has been experienced in the past by the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn., in obtaining a suitable drive which would give the desired buffing speed when using 60-cycle, alternating current. In a newly designed motor-driven buffing lathe this difficulty is said to have been overcome by mounting the motor on the back of the machine and connecting it with a chain drive to the grinding wheel spindle. By using appropriate sizes of chain sprockets the buffing spindle can be brought within close range of the desired speed.

The machine pedestal is cast with a bracket on the back on which the driving motor is mounted. This brings the center of the motor shaft horizontally back of the buffing spindle and the two are connected with the silent chain drive. This chain runs in an oil-tight case with an oil bath in the bottom, which insures continual and positive lubrication. Both the motor spindle and the buffing spindle run in ball bearings. The buffing spindle has four sets of bearings, one at each end of each box, and the boxes have large oil reservoirs into which the balls dip at each revolution.

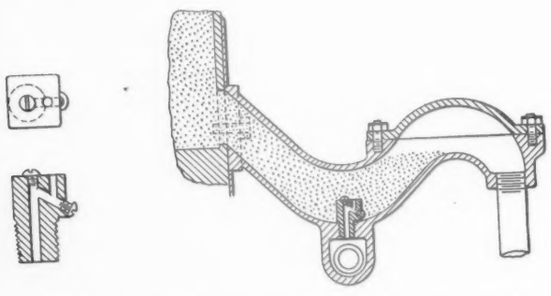
The machine is built in three sizes, each furnished with a 3,500 r.p.m., alternating current motor, which have a horsepower capacity of 2, 5 and 7½, respectively, giving a spindle speed of 2,400 and 2,500 r.p.m. The following dimensions are for the larger type of machine. The diameter of the spindle in the bearing is 2 in., length of the bearing 10½ in.; diameter of spindle where the wheel fits, 1½ in.; height from floor to the center of the spindle, 33 in.; net weight, 1,350 lb.



Motor-driven buffing lathe provided with a chain drive

Air nozzle for locomotive sanders

LOCOMOTIVE sanders of ordinary construction include a substantially straight air nozzle that is located in the lower portion of a pocket in the discharge pipe leading from the sand dome. It frequently happens that the duct in the air nozzle and the air chamber immediately beneath it become filled with sand. As a result of vibration, the sand becomes packed to such a degree as to prevent the compressed air, when turned on, from blowing through the sand discharge pipe, thus failing to serve its purpose.



Air nozzle designed to prevent the sand from packing in locomotive sanders

The air nozzle, shown in the illustration, has been designed in a manner which apparently overcomes this trouble. The air nozzle is seated in the bottom of the U-shaped portion of the trap immediately above the compressed air chamber and projects upwards into the passageway of the trap. The nozzle includes a rectangular metal body provided with an externally threaded shank that is screwed into the bottom of the trap. Formed through the body of the nozzle is an air duct the upper end of which is closed by means of a screw. There is formed in the upper portion of the body and immediately to one side of and parallel with the main air duct, a short duct extending a short distance down the body. These two air ducts are connected by a duct which is inclined at an angle of 45 deg. with respect to the horizontal. The lower end of this air passage is also closed with a screw plug. The three air ducts form a Z-shaped air passage, the inclined portion of which forms a trap between the

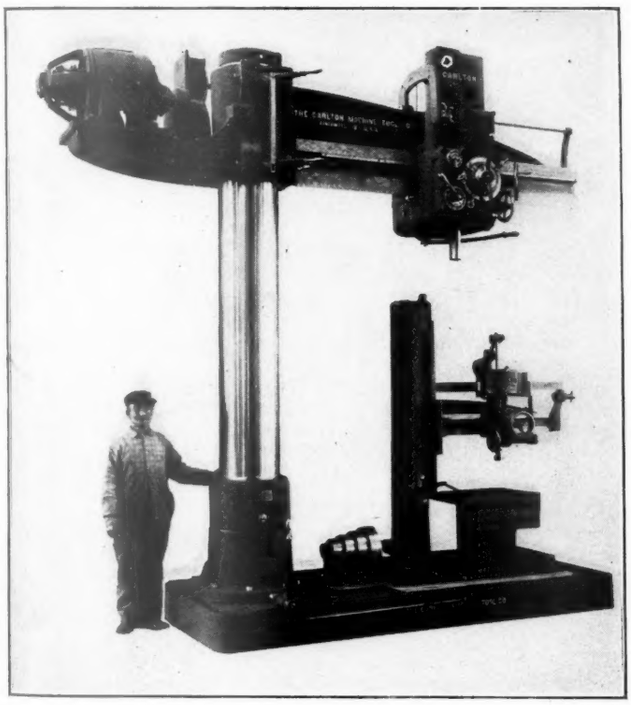
vertical portions that will receive and retain a relatively small amount of sand and consequently prevents the passage of any large amount of sand through the nozzle into the main air chamber. In this manner the sanders are prevented from becoming ineffective by the packing of sand within the air nozzles as it is only necessary to expel a relatively small amount of sand from the two smaller air ducts.

This device has been patented by John W. Simpson, Santa Barbara, Cal.

Ball bearing heavy duty radial drill

A RADIAL drill equipped throughout with ball bearings, constructed on the unit principle, having a concentrated and convenient control and a low-hung drive of the spindle, has been developed by the Carlton Machine Tool Company, Cincinnati, Ohio. Particular attention has been paid to lubricating the machine to increase production by reducing friction, wear, power losses, shutdowns and renewals.

The speed box is composed of several sub units. The driven shaft is provided with four keys running almost its entire length. The six gears which form the cone are made of alloy steel with four keyways multiple broached to fit on the shaft. The large gear on the end is made of cast iron which carries a pawl to drive the ratchet mounted on the shaft so that when the train of gears is disconnected, the pawl drops in the ratchet and keeps the gears in constant motion. The upper shaft, which carries the sliding tumbler gears, is also made from the solid bar. The ratchet teeth on the tumbler engage with a small segment on the front cover and are used only for engaging and disengaging the train of gears. The speed box is entirely closed with long levers extending to the front of the column for the convenience of the operator. The speed box contains a sight oil gage. There are 24 speeds in geometrical progression covering a range from 18½ to 800 r.p.m. when the speed box pulley is revolving at 500 r.p.m. A range of 24 to 1,000 r.p.m. may be obtained if desired by revolving the speed box pulley at 600 r.p.m. These high speeds are made possible by the fact that every bearing, shaft or sleeve is supported by ball bearings. There are 12 feeds mounted in the head, covering a range of .004 to .060 in. per revolution of the spindle.



Carlton 7-ft. heavy duty radial drill with the column lengthened to take 8 ft. 3 3/16 in. under the spindle

The stump knee has been designed as a complete unit in a housing. The horizontal shaft with bevel gears is mounted with ball bearings at each end. The bevel gear which carries the vertical shaft is mounted on a steel sleeve which is supported on each end with ball bearings. A sight oil gage indicates the amount of oil that these gears should run in.

The cap contains only three gears which are mounted on steel sleeves and supported on each end with ball bearings. These gears transmit the power from the center shaft to the outside vertical shaft. This unit runs in an oil bath which is controlled by a sight gage.

The arm knee elevator fits on the back of the arm and carries the bevel gears which transmit the power from the vertical to the horizontal shaft. These gears are also mounted in steel sleeves supported on each end with ball bearings. The power for raising and lowering the arm is taken from this unit. The tumbler gears are made up in a unit and mounted in the arm knee elevator. These gears tumble in mesh with the gear on the vertical shaft which is constantly in motion for raising and lowering the arm. This unit also runs in oil and has a sight oil level gage.

The head on the arm has two holes bored parallel, one for the weight and one for the spindle. Both the spindle sleeve and the counter-weight have generated teeth their full length and both balance on a pinion gear which is mounted in ball bearings. The head is designed with a low hung drive, with the train of gears underneath the arm which drives the spindle off its largest diameter down close to the work. In order to overcome wearing the head bell-mouthed, the large driving gear is mounted on a large semi-steel sleeve mounted on the head in two large ball bearings. The spindle does not revolve on this sleeve but simply slides up and down in a double keyway and when it reaches its maximum travel of 18 in. it still maintains 7 in. of bearing in the sleeve, which is mounted in large ball bearings 18 in. apart. A pump in the head supplies oil to the gears and bearings.

The only part which connects the transmission to the head is the driving gear in the transmission to the driven gear mounted on the spindle sleeve. The bottom part of the transmission sets in oil in the bottom of the head. This unit contains the reverse for both the gears and their clutches, one for the forward drive and the other for reverse for tapping. The multiple clutch in the unit has seven driving discs in the forward drive and the same number in the reverse.

The outer column of the machine hangs on two ball bearings mounted on the top of the inner column, a large thrust bearing to take the weight and a large radial bearing to take the radial load of the swinging arm, together with roller bearings mounted on the bottom of the column. The clamping mechanism for binding the inner and outer column consists of a pair of eccentric wedges of crescent shape, mounted between the two columns. The column

can be locked either by a hand lever or a foot treadle as shown on the front of the base.

The arm binding levers point toward the operator and are eccentric on the binding end so that the operator pulls down on the lever to bind the arm and pushes up to release it. There is a mechanism in the arm to prevent the operator from trying to raise it while it is clamped. When the arm reaches its maximum travel at the top of the column, it is stopped automatically by a plunger and if it should meet any obstruction while being lowered, it again stops automatically. This is accomplished by a stationary screw and revolving nut. The screw hangs on a friction bearing at the top of the column. The revolving nut is mounted in ball bearings in the arm. The weight of the arm on the screw creates the friction to keep the screw stationary, but when the arm strikes or rests on any obstruction, it releases the weight of the friction and allows the screw to turn with the nut. The power for rotating this nut is received from the rear shaft through a set of hardened tumbler gears.

The variable speed motor is mounted in the arm with an 11-point rheostat directly connected to the head which gives 24 speeds. Variation of speed is obtained by revolving the pilot wheel just above the levers on the head. This attachment is mounted on the head and slides along the spline shaft in the rear.

Hose dismantling and assembling machine

THERE appeared on page 780 of the December, 1921, issue of the *Railway Mechanical Engineer* a description of one of the first hose dismantling and assembling machines made by the Covington Machine Company, Inc., Covington, Va. Since the publication of this description considerable improvement has been made in the machine.

The machine is designed for the single purpose of dismantling and assembling air, signal and steam hose used in railroad work. It is a self-contained, air-operated machine which needs no special foundation and can be set up on the shop floor under a shed or in any location convenient to an air line with from 85 lb. to 100 lb. pressure.

The changes in the design start with the frame *A*, Fig.

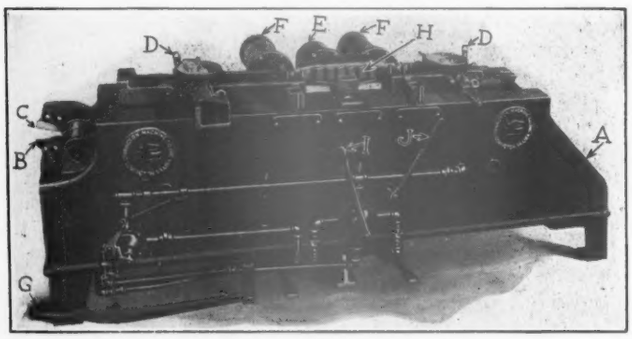


Fig. 1—Covington machine set to remove the couplings from both ends of the hose at one operation

1, which is made with cored openings in the top and out through the rear side, which allows the old metal parts when stripped from the hose to pass through the machine and drop into boxes. The knife block *B* and knife arm *C*, used for cutting the clamp bolts on the old hose, have been lowered below the top surface of the frame, allowing the sliding turret with the attached tools to pass over the top knife arm. Instead of a fixed sliding head, revolving turrets with all the dismantling and assembling tools mounted on them, have been mounted on the sliding crossheads. Thus, the tools are ready for instant use by simply removing the indexing pins *D* and revolving the turrets to bring the tools desired into working position.

A 6-in. clamping cylinder *E* has been mounted horizontally with the double pistons *F* for use when clamping old hose to be dismantled and holding new hose when assembling.

The methods of performing the various operations on the machine have been materially changed. The operations for stripping old hose are as follows: Referring to Fig. 1, the clamp bolts are first cut by the two knives *B* and *C* without injuring the hose clamps. The valve con-

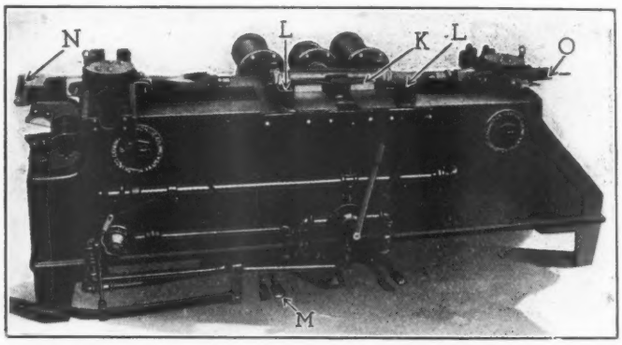
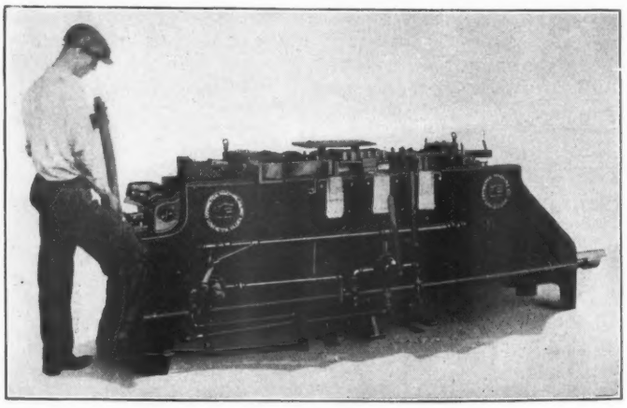


Fig. 2—Machine set for the first operation when assembling air or steam hose

trolling this operation is operated by the foot treadle *G*, thus leaving both hands free to hold the hose.

The operator now moves to the front of the machine and throws lever *I* to the left which brings the turrets



Performing first operation of shearing the clamp bolts on the hose

carrying the pulling blocks toward the center of the machine. The hose is then dropped in between the clamping head *H* with the coupling end of the hose to the left in the puller block, the coupling being in the larger opening and the clamp in the smaller opening. The nipple end

rests in the right puller block with the nipple in the larger opening toward the turret center and the clamp in the other opening. The lever *J* is now thrown to the right, clamping the hose in the heads *H*. Lever *I* is then thrown to the right, which, by means of a series of air operated levers, moves the pulling blocks away from the center of the machine, stripping off the nipple, coupling and clamps which drop through the frame of the machine. Lever *I* is then moved back to the left releasing the hose. The nipple, or coupling ends of either air, steam, or signal hose are handled in the same way, with the tools mounted on the revolving turret head.

In assembling an air hose, a new hose is laid in the trough *K*, Fig. 2, with the fitting in each end and the two clamps loosely mounted. The heads *L* are brought toward the center of the machine by the operator stepping on treadle *M*, which squeezes the clamp around the hose while holding it in position. While holding the clamp in this position, the operator inserts a clamp bolt, puts on a nut and the hose is completely assembled. In assembling steam hose, the operation is exactly the same except that the assembler *N* is used for the coupling and the stem *O* for the nipple.

The speed of the machine depends on the operator's willingness to work. On test, one operator is said to have dismantled 240 standard air hose in 60 min., which is an average of one every 15 sec. The signal hose required a little longer time because of the small nipples, but 200 per hour were dismantled without trouble. The same operator assembled 55 standard air hose in 60 min. It required 60 min. to assemble 45 signal hose and 60 min. to assemble 35 steam hose.

Air dump car with traversing and tilting body

AN air dump car with a capacity of 100,000 lb., a cubic capacity of 28 cu. yd. level full, or 43 cu. yd. with a normal crown load, has recently been placed on the market by the Differential Steel Car Company, Findlay, Ohio.

In dumping, the movement of the body is first a lateral movement across the underframe during which time the side folds down to the same plane as the floor. The body

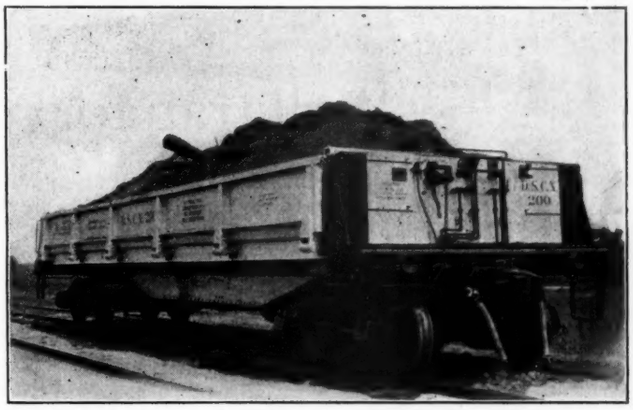
Differential dump car in the dumping position

then tilts and is balanced in all positions. The car is thus able to dump the material clear of the track. The dumping mechanism is so arranged that part of the load may be discharged without discharging the remainder, as it is easy to arrest the motion of the body at any desired angle and to bring the body back to the horizontal position. In this way material may be distributed when and where desired. It is equally as easy to dump to either side of the car as the air control lever governs the entire dumping operation which simply requires moving the control lever in the desired direction. There is no part of the car which offers any obstruction to the discharge of its load. This is particularly important in dumping large boulders where an obstructed opening would render discharge impossible. The floor of the car is perfectly smooth, with no projecting rivet heads or other obstructions which might impede the discharge of the load. The door is hinged in such a manner that there is always a sealed joint between the door and the floor. The door folds under the floor plate so that at no time is there a crack between the two.

The distance from the rail to the top of the sideboard is only 7 ft. This height may be further reduced for hand loading by the simple expedient of lowering the door, thus reducing the loading height to the floor level, which is about 4 ft. 6 in. above the rail. The operation of opening and closing the doors is executed by means of the air dumping mechanism. It is possible to operate the car on a pressure as low as 40 lb.

The dumping mechanism is provided with a mechanical interlock which keys the body to the underframe. This locking device operates as part of the dumping control. There is no chance of accidental dumping due to leaky valves or other causes.

The car is of all-steel construction, complies with A. R. A. standards, and is equipped with United States safety appliances. The body is supported on two lines of rollers



An air operated dump car with a traversing and tilting body

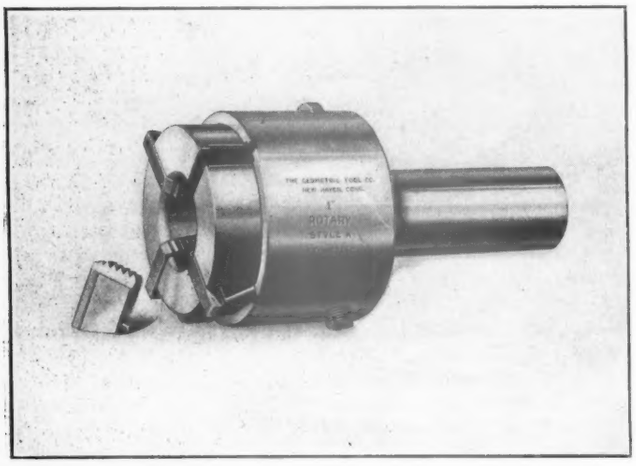
on 2-ft. centers and at 7-ft. intervals the full length of the car. These rollers operate in the raised sections of the floor. This method of support gives greater stability because the two lines of support are at about the same height as the center of gravity of the loaded body. It strengthens the floor of the car and renders the body much less likely to be damaged by heavy pieces of material being dropped into the car. These raised sections of the floor also serve as an excellent protection to the mechanism. The moving parts of the operating mechanism are

equipped with large bronze and graphite oilless bushings.

The car is dumped by means of a rugged air motor operating through a worm gear reduction, all enclosed in an oil-tight case. It is controlled by air and the control is so arranged that any number of cars may be dumped in a train from one car to either side in less than one minute. Any car may be locked so that it will not dump. An entire train may be dumped from the locomotive in either direction. The operator, standing on one of the cars of a train, can dump all cars ahead of him in one direction and all to the rear in the other. This control is universal so that any combination can be secured.

Rotary self-opening die head

THE rotary self-opening die head shown in the illustration has been designed by the Geometric Tool Company, New Haven, Conn., with particular reference to the various types of multiple spindle automatics and other live spindle machines. Owing to its small diameter, it swings freely in the limited space afforded by many of the modern automatic screw machines.



Geometric Style K rotary self-opening die head

It is constructed in three units which are completely enclosed, thus keeping out dirt or chips from the mechanism. The opening and closing of the die head is effected by the forward and backward movement. It is designed so that the chasers project beyond the face of the die head, permitting threads to be cut to a shoulder without any adjustment, and also giving maximum chip clearance. All the working parts are ground, including the entire sliding surface of the slots in which the chasers are located.

The threading chasers, while in the cutting position, are rigidly supported on all sides and at the top; they are completely boxed in, except in the face, where the teeth are located. The wide slots in which the chasers fit allow them to be large in size, thus providing durability. The chasers can be instantly removed or replaced, for there is no removing of the face plate or screws in order to get the chasers in or out. This construction eliminates the necessity of lining up cam slots before the die head can be locked. Chasers for cutting left and right hand threads are interchangeable.

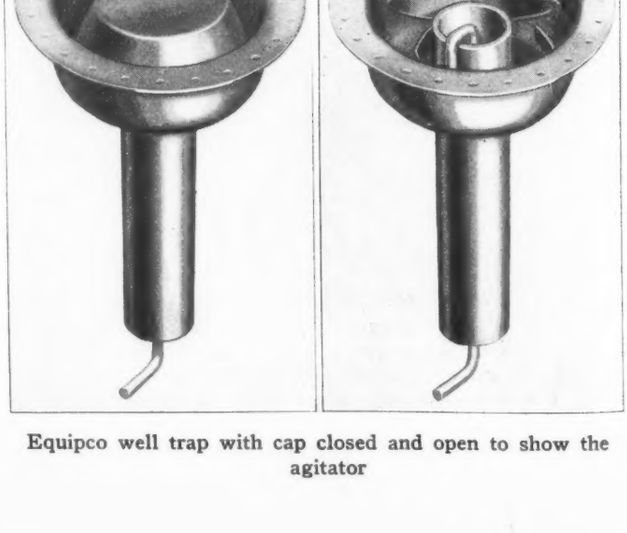
The die head is characterized by its simplicity in operation. When the spindle is advanced, a stop provided on the machine makes contact with the trip on the outside of the tool the moment the desired length of thread has been cut. This opens the die head. When the spindle is returned, the die head is closed by a yoke on the machine which makes contact with the rear of the die head closing sleeve.

This die head is known as Style *K* and is made to take the following stock sizes: 9/16 in., 1 in., 1¼ in. and 1½ in.

Well trap for refrigerator cars

A NEW well trap with permanently attached agitator has been developed for use in refrigerator cars by the Equipment Specialties Company, Chicago. The well trap itself is made of pressed steel and consists of a bowl and cap with a standard wrought iron overflow pipe, pressed into the bowl bottom flange and further secured by two ¼-in. hot driven rivets. The hinges are heavy and are well secured, being located where they can be readily inspected and the brass cotter pin easily applied. The drain is heavily galvanized and not likely to break owing to its pressed steel construction.

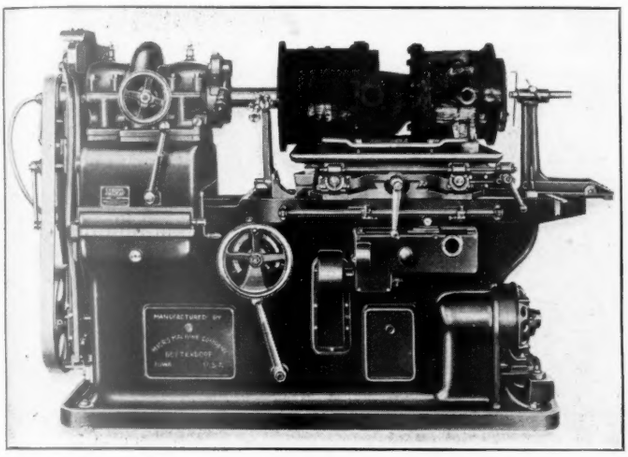
The agitator is a permanent part of the trap and is operated from the outside of the car. By its use the sediment or accumulation which collects in traps can be broken up and allowed to flow out of the overflow pipe, thus preventing the clogging of drains and flooding of car floors. The agitator reaches all parts of the bowl and is positive in effect. It also raises the flare-sided seal cap and further agitates the sediment. The cap of its own accord drops back into place and the water seal is again intact. Either a straight overflow pipe, or one with a 10-deg. offset from the vertical in order better to clear the journal box lid, can be provided.



Equipco well trap with cap closed and open to show the agitator

Internal grinder for railroad shops

THE illustrations show a new machine recently developed by the Micro Machine Company, Bettendorf, Iowa, and designed exclusively for grinding work in railroad shops. With suitable work-holding fixtures the machine will grind all bushing and pin holes in locomotive rods, running gear, air brake valve cylinders and similar parts. By means of a special swiveling table, air compressor cylinders can be ground



Micro internal grinder refinishing the worn cylinders of a cross compound air compressor

without unbolting them from the center castings and with the assurance when the job is done that the cylinders will be smooth, accurately round and without taper, and the axes in exact alinement, thus tending to prevent piston rod packing troubles and provide more efficient compressors. The standard range of the machine is 2½-in. to 10-in. holes, 13 in. deep. With special spindles, 1-in. to 15-in. holes, 19 in. or more in depth may be ground.

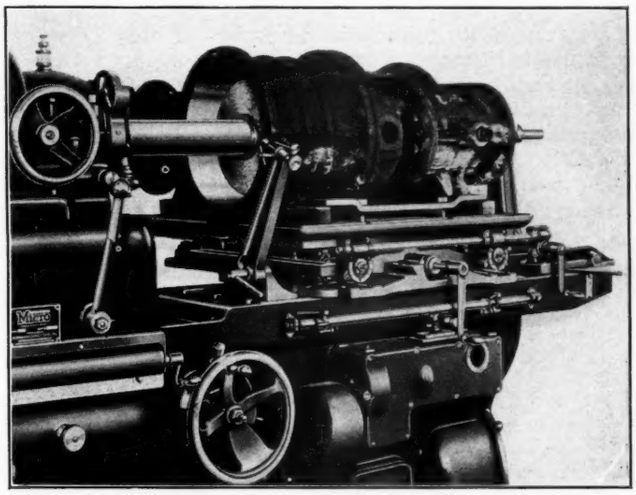
The Micro grinder has several new features of special interest. The driving motor and mechanism are a part of the machine, power being transmitted to the grinding spindle by a counterbalanced pantagraph arrangement which assures a constant speed of the grinding wheel without back lash of the belting and thus promotes more smooth, accurate work. By practically eliminating vibration from the source of power through to the finished job, maximum smoothness is assured.

An adjustable speed headstock is provided, enabling the correct relation between work speeds and wheel travel to be maintained. In determining the correct relation of these two variables, the builder conducted exhaustive experiments demonstrating that the orbital speed which is correct for a small hole is too rapid for a large hole and that, given the proper work travel, an unusual amount of stock (up to 1/32-in. in cast iron) may be removed in one cut regardless of the size of the hole. Orbital headstock speed control is one of the most important features of the new grinder.

The Micro grinder is equipped for wet grinding. During the operation, a cooling compound is forced through the center of the patented main spindle and centrifugal action throws it directly between the wall of the hole and the grinding wheel. By keeping the work cool distortion due to unequal expansion and contraction is prevented. The cooling compound then drains into a clarifier tank where all sediment and oil is removed assuring the delivery of clean grinding compound to the work.

Force feed lubrication is provided for both the headstock and the gear box. All oil holes are protected by filters to prevent dust and grit getting into the bearings, the lubrication being retained by special seals. There are five table feeds to take care of various depths of cut of the work. The eccentric feed can be made coarse or fine while the machine is in operation. For centering the work, rapid hand feed is provided.

The reverse gear box is an enclosed unit also provided with automatic force feed lubrication. The table change feed worm and gear box and all other running units are equipped with the Alemite system of lubrication. The drive for the machine consists of a 3-hp. motor located



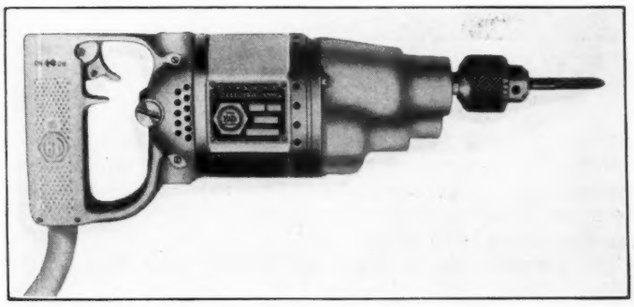
Close-up view showing compressor holder and swiveling table

in the rear end of the base and controlled by a friction clutch with a lever conveniently located near the operator on the front of the machine.

The Micro grinder is designed to combine precision and accuracy with a flexibility and ready change from one job to another which suits its demands.

Portable electric tapper

AN electric tapper with an automatic reverse is a recent addition made by the Black & Decker Company, Towson, Md., to its line of portable electric tools. It is similar in design and construction to the



Black & Decker electric tapper which has an automatic reverse

other electric tools made by the same company except that the mechanism in the gear case is so designed that

the tap is driven in at a speed of 350 r.p.m., by a slight backward pull on the machine, the tap chuck is automatically reversed and the tap backed out of the threaded hole at double the speed it is driven in, thus eliminating a reversing switch.

It is adapted to a wide range of work as it will tap holes in steel up to ¼ in.; in cast iron, up to ⅜ in. and in brass or aluminum, up to ⅝ in. The machine weighs approximately 8¾ lb.

Melting furnace for soft metals used in railway shops

THE melting of soft metals for locomotive crossheads, driving boxes, etc., is an extensive practice in railway shops. A melting furnace adaptable to this class of work has been recently added to the line of gas furnaces and appliances manufactured by the Johnson Gas Appliance Company, Cedar Rapids, Iowa. It is fitted with a removable cast-iron melting pot with a capacity of 300 lb. of metal.

The pot has a removable lid and an outlet valve for drawing off the molten metal. The heating element

The Johnson 300 lb. capacity melting furnace

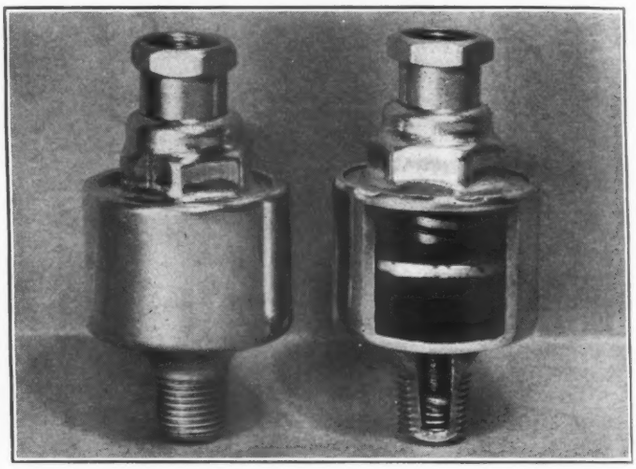
consists of three large direct-jet Bunsen burners. They are said to be equal to an air-blast outfit in rapidity of heating, and at the same time to be more economical in gas consumption and easier to operate which are desirable features for railway shops.

The furnace can be used for melting lead, tin, white metal, babbitt, solder scrap and all other low or medium fusion metals and alloys. It can also be used for cyanide hardening, oil tempering and the melting of various chemicals. The over-all height of the furnace is 31 in. and the weight complete is 185 lb. The gas consumption is 85 cu. ft. per hour.

National grease cup with an automatic feed

A GREASE cup designed to feed semi-liquid lubricants to shop machinery, elevators, shop trucks, etc., has been put on the market by the National Automatic Grease Cup Company, Chicago. This cup, which is substantially made, does not replace other lubricating systems, merely adding to them a reservoir containing sufficient semi-liquid grease or heavy oil for many hours of operation.

The cup does not require any special fitting for applica-



Automatic grease cup which is filled with a pressure gun

tion as the top stem will accommodate any type of fitting. The position of this stem indicates when the cup is full or empty.

A uniform feed is obtained regardless of the pressure exerted by the spring on the main stem. The flow is controlled by a screw slot adjustment located in the lower shank of the cup. This slot is turned only in an anti-clockwise direction. It is not necessary to remove any caps for filling as any type of pressure gun may be used for this purpose.

REPAIRING LOCOMOTIVE GUIDES.—An interesting exhibit was brought to the attention of railroad men at the National Railway Appliance Association's exhibition at the Coliseum, Chicago, recently. A new process for repairing locomotive guides was displayed, by means of which the General Electric Company claims to have eliminated all difficulties previously encountered in renewing these guides and keeping them up to I. C. C. standards.

The process used was electric arc welding automatically applied. The guides were placed in an ordinary lathe and the automatic welder was mounted on the tool post. When in operation, the guide remained stationary and the automatic welder traveled along with the carriage of the lathe, depositing electrode metal on the worn surface of the guide. The welding was applied on the side surface of the guide covering a width of 2 in., beginning on the inside and laying down adjacent beads, working to the outer edge. Two layers of beads were required to build up the worn spot, a total of ⅜ in. on each side. This was then machined away ⅛ in. on each side, leaving ¼ in. finished built-up stock. The length of the built-up guide was 5 ft. A total of three hours was required for welding both sides using 150 amperes, 20 volts across the arc and ⅛ in. diameter electrode wire.

Figures obtained from a railroad now using this process indicate a saving of almost 50 per cent when automatic electric arc welding is used in preference to the oxy-acetylene process.

General News

Locomotive Inspection Bureau's February report

The Bureau of Locomotive Inspection in the month of February inspected 5,732 locomotives, of which 2,648, or 46 per cent, were found defective and 267 were ordered out of service, according to the Interstate Commerce Commission's monthly report to the President on the condition of railroad equipment. The Bureau of Safety during the same month inspected 96,249 freight cars, of which 3,803, or 3 per cent, were found defective, and 1,523 passenger cars, of which 27 were found defective. Twenty-two complaints, involving 50 violations of the safety appliance acts, were transmitted to various United States attorneys for prosecution.

Suit between Brown Instrument Company and Republic Flow Meters Company settled

The suit brought by the Brown Instrument Company in the Federal Court at Chicago against the Republic Flow Meters Company and certain individuals has been settled between the parties; also certain suits at law brought by the Republic Flow Meters Company and the same individuals in the same court against Richard P. Brown have been dismissed.

The officers of the Republic Flow Meters Company did not wish to be under the imputation of illegally using any of the original construction of the Brown instruments. It having been called to their attention that there were pending on behalf of the Brown Instrument Company patent applications covering some of these features, the Republic Flow Meters Company has changed the construction of its indicating and recording pyrometers for the purpose of avoiding infringement either of patents or of original design or construction of the Brown Instrument Company.

Wage statistics for 1924

The Interstate Commerce Commission has issued a summary of railroad wage statistics for the twelve months ended with December, 1924, a consolidation of the monthly summaries heretofore issued, with certain minor changes.

The average number of employees reported for the year was 1,777,391, a decrease of 102,379, or 5.4 per cent, as compared with the preceding year. The total compensation was $2,867,564,802, a decrease of $175,596,361, or 5.8 per cent. Compared with the previous year, the average straight time hourly earnings for all employees reported on an hourly basis increased from 56.5 to 57.7 cents, and the average overtime hourly earnings increased from 76.8 to 80.4 cents. But owing to a reduction in the number of overtime hours worked, the percentage relation of overtime to total compensation decreased from 8.24 to 6.04.

The tables show, for employee groups: (1) the average annual compensation, the decrease in the average number of employees, and the increase or decrease in 1924, as compared with 1923; (2) the average straight time earnings per day or hour for the years 1924, 1923 and 1922, and last half of 1921; and (3) average earnings by districts for 1924. The reason for showing the last half of 1921 separately is that the present classification of employees became effective July 1, 1921. This is also the date of the general reduction in wages following the increases of 1920.

N. P. fuel economy slogan

"A scoop of coal dumped with the ashes in the clinker pit every time a fire is cleaned on a Northern Pacific locomotive would waste $15,000 a year. A single pound of coal wasted daily in each station stove would cost $7,000 a year. Savings in similar amounts may be effected with proper attention." So read the announcement of a fuel economy slogan contest open to every Northern Pacific employee, which ran from October 30 to December 10, 1924.

During the contest 2,100 slogans from nearly 450 participants were submitted. The winner of the first prize of $50 is J. J. Schmidt, chief yard clerk at the Fourth street yards, St. Paul, Minn. His slogan, accompanied by a triangular design about which the words are attractively grouped for display purposes, is shown in the illustration. B. M. Pederson, of the office of the auditor of freight receipts, St. Paul, was the winner of the second prize of $25. His slogan is "Coal, burn it as your own."

The slogan idea arose with the committee of the Northern Pacific representatives who attended the convention of the International Railway Fuel Association at Chicago last May. Practically every department on every division of the railroad was represented in the slogans submitted. The contest judges were C. L. Nichols, general manager; T. J. Cutler, mechanical superintendent, and M. M. Goodsill, assistant general passenger agent.

The first prize slogan will be used in the form of stickers and on envelopes, letter heads and engine equipment, including shovels. It will also be posted wherever coal is used on the railroad.

Locomotives ordered, installed and retired

Month 1924	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort	Building in R. R. shops
January	271	15,228,895	178	4,447,721	64,989	2,552,694,953	14
February	214	11,296,088	175	4,906,435	65,029	2,559,519,253	10
March	176	10,457,064	181	6,033,173	64,911	2,560,076,766	7
April	97	4,167,388	112	2,881,385	64,896	2,561,362,769	11
May	153	6,949,353	107	2,600,445	64,942	2,565,706,413	10
June	160	7,687,383	178	4,575,358	64,924	2,569,121,875	72
July	197	10,590,558	113	3,354,456	65,008	2,576,433,377	63
August	229	12,513,395	166	5,346,176	65,062	2,583,372,980	50
September	160	7,061,560	151	4,351,378	65,071	2,586,083,994	37
October	113	5,743,775	220	5,712,633	64,964	2,586,106,026	76
November	181	8,460,795	263	7,749,794	64,882	2,586,826,278	70
December	295	12,311,451	304	9,724,426	64,871	2,589,358,971	64
Total for year 1924	2,246	.....	2,148	.....	.....	.....	...
January, 1925	167	7,455,971	213	6,242,079	64,824	2,590,525,478	81
February	...	.....	...	.....	.....	.....	...
Total for 2 months	...	.....	...	.....	.....	.....	...

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in Form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Pere Marquette has correspondence course in efficient car handling

A correspondence course for the instruction of its employees in the principles of efficient car handling as established by the present car service and Per Diem rules was arranged by the Pere Marquette several months ago. The course is available to all employees regardless of their occupation and 282 have enrolled in it. Although some dropped out after a few lessons, a considerable number have consistently studied and reported on the lessons submitted.

The course consists of six lessons, each accompanied by a list of questions which are to be answered and returned before the succeeding lesson is released. The answers to these questions are carefully checked to determine whether the employee has correctly interpreted the facts as given in the lesson and all misunderstandings are corrected by letter. The subjects discussed in the six lessons are as follows: Lesson No. 1 covers the general theory of car distribution with tables showing the ratio of loaded and empty car miles to total car miles, the average number of cars on line per day and the average miles per car per day, with explanations of the various terms used and methods by which the comparative statements are arrived at. Lesson No. 2 quotes car service rules governing the handling of empty cars of connecting railroads and charts the junction points of the Pere Marquette with connecting lines. Lesson No. 3 explains the Pere Marquette's system of car distribution, directing attention to the geographical location of the lines, as well as to the different kinds of freight general office car records, manifest freight and car tracing, and handled in local territories. Lesson No. 4 explains the interchange report and the Per Diem rule. Lesson No. 5 discusses the Lesson No. 6 is devoted to car demurrage.

C. M. & St. P. military organization

The 609th Engineers' Battalion of the United States Army, the military railway organization on the Chicago, Milwaukee & St. Paul, now has its commissioned personnel up to full peace strength, with 18 officers for the four companies, a headquarters company, an operating company, a maintenance of way company and a mechanical company. The enlistment of additional men for the ranks is now in progress, seven men having been enrolled already. This is believed to be the first reserve organization of its kind to have its commissioned personnel up to full peace strength. Norman A. Ryan, division superintendent at Terre Haute, Ind., where the battalion headquarters is located, is the commanding officer of the unit. The organization of the commissioned personnel of the battalion is as follows:

609th engineers' battalion (C. M. & St. P. Ry.)

Name	*Grade*	*Civilian Duty*	*Location*
Headquarters			
N. A. Ryan	Captain	Superintendent	Terre Haute, Ind.
I. C. Jordan	Captain	Staff of Vice-president	Chicago, Ill.
G. M. Hayden	Captain	Chief Dispatcher	Tacoma, Wash.
H. G. Bernard	1st Lieutenant	Dispatcher	Ottumwa, Iowa.
E. A. Lalk	1st Lieutenant	General Agent	Milwaukee, Wis.
J. G. Bruce	1st Lieutenant	Agent	Bozeman, Mont.
Company A (M. of W.)			
C. F. Allen	Captain	Roadmaster	St. Maries, Idaho.
N. F. Podas	1st Lieutenant	Assistant Engineer	Minneapolis, Minn.
V. Hansen	1st Lieutenant	Chief Carpenter	Montevideo, Minn.
R. V. Cummings	2nd Lieutenant	Freight Department	Great Falls, Mont.
Company B (Mechanical)			
E. Jones	Captain	Engineer	Spokane, Wash.
J. H. Hale	1st Lieutenant	General Foreman	Galewood, Ill.
H. Wallace	2nd Lieutenant	General Foreman	West Clinton, Ind.
R. C. Visger	2nd Lieutenant	Locomotive Engineer	Chicago, Ill.
Company C (Operating)			
F. R. Doud	Captain	Chief Dispatcher	Bellingham, Wash.
E. Kiesele	1st Lieutenant	General Yardmaster	Dubuque, Iowa.
C. G. Ellis	2nd Lieutenant	Locomotive Engineer	Milwaukee, Wis.
C. G. Gepner	2nd Lieutenant	Night Chief Dispatcher	Terre Haute, Ind.

C. M. & St. P. in receivership

On March 18 a receivership for the Chicago, Milwaukee & St. Paul was established by Judge James H. Wilkerson, United States District Court, at Chicago, who appointed as receivers H. E. Byram, president of the C. M. & St. P.; Mark W. Potter, who recently retired from the Interstate Commerce Commission, and Edward Brundage, former attorney general of the State of Illinois. It was decided by the board of directors that in all probability the road would be unable to meet the $48,000,000 maturities due on its bonds on June 1. The causes contributing to the company's present difficulties are considered to be as follows:

1. The competition of the Panama Canal, which, by reason of the low freight rates between the Atlantic seaboard and the Pacific Coast, and also to the Far East, via the canal, has been heavily felt by all transcontinental lines, and particularly by the Chicago, Milwaukee & St. Paul because of the large percentage of its investment in the Puget Sound extension.

2. The depressed agricultural and business conditions of the past few years in the Northwest, where a large part of the company's traffic originates. Passenger earnings, which were $31,034,000 it 1920, were only $21,768,000 in 1924, due largely to motor vehicle competition.

3. The large increases in the cost of labor and materials and in taxes, which have not been offset by corresponding increases in rates or in volume of traffic.

4. The lack, for a number of years, of surplus earnings to apply toward necessary improvements, betterments, etc., the consequences of which are that the current position of the company is unfavorable, and that its equipment has suffered deterioration and is insufficient in amount.

Court decisions

Non-compliance with labor board decision held not a conspiracy.—The Supreme Court of the United States has affirmed the decree of the Circuit Court of Appeals, Third Circuit, 1 Fed. (2nd) 171, affirming the decree of the Federal District Court for eastern Pennsylvania, 296 Fed. 220, dismissing the bill of the Pennsylvania Railroad System and Allied Lines Federation No. 90 against the Pennsylvania. The issues involved the construction and application of Title III of the Transportation Act of 1920, and the controversy was a continuation of that considered in Pennsylvania v. Labor Board, 261 U. S. 72.

The bill in the present case was filed to enjoin what was charged to be a conspiracy by the Pennsylvania and its officers to defeat the provisions of the Act and deprive the employees of the rights with which the provisions of Title III of the Act intended to vest them in their dealings with the company; averring that in the effort to deprive them of their proper representation and maintain the plan of the company, the company resorted to coercion with threats of discharge, and further violated their rights by preventing a large number of employees who were furloughed from casting their votes in the election.

The whole issue in the case, the Supreme Court said, "is whether Title III in pointing out what Congress wished the parties to the dispute to do was intended by Congress to be a positive, obligatory law. * * * The Supreme Court has decided that there is nothing compulsory in the provisions of the statute as against either the company or the employees upon the basis of which either acquired additional rights against the other which can be enforced in a court of law.

"What the complainants are seeking to do," the court said, "is to enforce by mandatory injunction a compliance with a decision of the Board not based on the legal rights of the parties, but on its judgment as to what legal rights the disputants should surrender, or abate in the public interest and in the interest of each other, to maintain harmonious relations between them necessary to the continuance of interstate commerce, and to avoid severing those

Freight car repair situation

1924	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1	2,279,363	118,653	39,522	158,175	6.9
April 1	2,274,750	125,932	46,815	172,747	7.6
July 1	2,279,826	144,912	49,957	194,869	8.5
October 1	2,304,020	157,455	48,589	206,044	8.9
1925					
January 1	2,293,487	143,962	47,017	190,979	8.3
February 1	2,305,520	139,056	47,483	186,539	8.1

Month	Cars repaired: Heavy	Light	Total
December	87,758	2,073,280	2,161,038
March	77,365	2,213,158	2,290,523
June	70,480	1,888,899	1,959,379
September	74,295	1,372,277	1,446,572
December	66,615	1,288,635	1,355,250
January, 1925	69,084	1,358,308	1,427,392

Data from Car Service Division reports.

relations as they would have the strict legal right to do. Such a remedy by injunction in a court it was not the intention of Congress to provide."

The complainants also sought damages on behalf of the members of Federation No. 90. First, for employees on furlough when notified to return on the scale of wages made effective by the company July 1, 1921, who refused to return except on the old scale prevailing September 1, 1920, and who sought wages though they did not work. Second, employees who worked under the company scale for a year and then struck, who claimed the difference between the old and new scales. Third, those who did not strike, but accepted wages on the new scale, who claimed the difference between the two scales till the filing of the bill.

The court did not find it necessary to consider these claims on their merits. "Even if the Federation No. 90 and its members as representatives in a class suit in equity could recover such claims as damages incidental to granting the main equitable relief prayed for, the denial of the prayer for the equitable relief and the dismissal of the main part of the bill carries with it such incidental claims without prejudice to their prosecution at law by individual claimants as they may be advised."—Pennsylvania System and Allied Lines Federation No. 90 v. Pennsylvania. Decided March 2, 1925. Opinion by Chief Justice Taft.

Meetings and Conventions

American Railway Association headquarters for London Congress

The American Railway Association will have headquarters for its delegates to the International Railway Congress to be held in London on June 22 to July 12 at the Hotel Cecil, the Strand, London. Representatives of railways which are members of the association are invited to make use of the facilities at the headquarters, which will include translations into and from the French, stenographic service, assistance with bookings and the like.

American Welding Society

The annual meeting of the American Welding Society will be held on April 22, 23 and 24 at 29 West Thirty-ninth street, New York. The tentative program for this meeting is as follows:

Wednesday, April 22.

9:00 a.m.—Resistance Welding Committee meeting.
11:00 a.m.—Gas Welding Committee meeting.
2:00 p.m.—Electric Arc Welding Committee meeting.
8:00 p.m.—Educational Committee meeting.

Thursday, April 23.

9:30 a.m.—Business session American Welding Society.
1:45 p.m.—Inspection trip to Bay Way plant, Standard Oil Company.
7:00 p.m.—Annual dinner, Park Avenue Hotel.

Friday, April 24.

9:30 a.m.—Technical session.

Symposium.

1.—Methods of inspecting welds.
2.—Testing the skill of operators.

12:00 m. —Luncheon Engineers' Club.
12:45 p.m.—Technical session continued.
2:00 p.m.—American Bureau of Welding.
3:30 p.m.—Board of directors, American Welding Society.

Annual meeting of the Mechanical Division, American Railway Association

The annual meeting of the Mechanical Division, American Railway Association, will be held at the Drake Hotel, Chicago, June 16, 17 and 18, 1925. This meeting is to be strictly a business meeting and is confined to members authorized to represent and vote for the railroads, and members of committees. There is no objection to any railroad sending such representative members as they may desire. The business to be taken up will be the consideration of and acting upon reports of the various committees. In addition, two or three individual papers on important subjects will be presented and discussed. All voting representative members of the railroads are urged to be present, in order that proper consideration may be given to all committee reports and subjects coming before the Mechanical Division and proper action taken.

Wood Preservers' Association

On account of the growth of the work of the American Wood Preservers' Association, the office of secretary has been divorced from that of secretary-manager of the Service Bureau and E. J. Stocking has been appointed secretary with office at 111 West Washington street, Chicago. P. R. Hicks continues as secretary-manager of the Service Bureau of the association with office at 10 South La Salle street, Chicago, devoting his full time to the work of that organization. The Executive Committee of the Wood Preservers' Association has also reconsidered the action taken at the annual convention relative to the location of the next meeting and has selected Cleveland for the convention which will be held on January 26-28, 1926.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting May 26-29, inclusive, Alexandria Hotel, Los Angeles, Cal.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Business meeting to be held in Chicago June 16, 17 and 18. No exhibit of railway supplies and machinery will be held.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September, 1925.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Next meeting May 19, 20 and 21, at St. Louis, Mo.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention August, 1925, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third street, New York. Spring meeting May 18 to 21, inclusive, Milwaukee, Wis.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting, June 22-26, Chalfonte-Haddon Hall, Atlantic City, N. J..

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. K. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday each month, Hotel Statler, Buffalo, N. Y. Next meeting April 9. Paper on billing in transit, mixing in transit and reconsigning will be presented by W. B. Errington, local freight agent, Nickel Plate, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Fredricks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland. Next meeting April 6. Paper on Oxy-acetylene process will be presented by G. C. Harcke. A film "Oxygen the Wonder Worker," will also be shown.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill. Next annual convention May 26-29, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FORFMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 19-25, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting April 14. A paper on purchases and stores will be presented by C. D. Young, Pennsylvania railroad.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Next meeting April 17. Prof. W. M. Daniels, Yale University, will speak on what branches of transportation technical schools and universities attempt to teach. Entertainment by B. & O. Glee Club.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Next meeting April 9. Paper on Manufacture of Pure Iron, by T. Faw, California Corrugated Culvert Company, and a paper on the Reclamation of Railway Springs, by F. H. Pelle. E. F. Houghton Company, will be presented; also motion pictures illustrating the manufacture of pure iron.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEER'S ASSOCIATION.—W O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 15-18, 1925, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison St., Chicago. Annual meeting May 23, Edgewater Beach Hotel, Chicago.

Supply Trade Notes

The Lehon Company, Chicago, has moved its New York office from 95 Liberty street to 60 Broadway.

The General Piston Ring Company, Indianapolis, Ind., has moved its plant and offices to Tipton, Ind.

The Hubbard Steel Foundry Company, East Chicago, Ill., is constructing a machine shop, 150 by 120 ft.

C. C. Fredericks, vice-president and general manager of the W. N. Matthews Corporation of St. Louis, Mo., has resigned.

C. R. Naylor, sales agent of Symington Company at 2108 Straus building, Chicago, has been appointed manager western sales.

The Standard Stoker Company has removed its New York City office from 5054 Grand Central Terminal to 350 Madison avenue.

The Jordan Machine Company, Minneapolis, Minn., will construct a one-story and basement machine shop addition 70 by 120 ft.

R. M. Taylor, assistant general manager of the Thomson Electric Welding Company, has resigned to go with Congoleum-Nairn, Inc.

The Woodman Railway Supply Company, Railway Exchange building, Chicago, has been incorporated to take over the sale of journal boxes, including the Joliet and Franklin boxes, formerly handled by the Northwestern Malleable Iron Company, Milwaukee, Wis. Officers of the new company are, president, G. A. Woodman, sales manager of the Northwestern Malleable Iron Company; vice-president and secretary, A. M. Talbot, vice-president of the A. H. Talbot Company; treasurer, A. M. Tufts, manager of the Commercial Utilities Company. Mr. Woodman was born in Dunkirk, N. Y., in 1866, and in 1883 entered the employ of the Brooks Locomotive Works as a machinist, later becoming a draftsman. In 1887 he was appointed mechanical engineer of the Milwaukee & Northern, now a part of the Chicago, Milwaukee & St. Paul, which position he held until 1889, when he returned to the employ of the Brooks Locomotive Works as a draftsman. From 1891 to 1895 he was a draftsman for the Illinois Central and in the latter year was appointed chief draftsman of the Lima Locomotive & Machine Company. In 1897 he was appointed assistant master car builder of Swift & Company, Chicago, which position he held until 1898 when he was appointed assistant superintendent of the American Car & Foundry Company, Chicago. In 1900 he became mechanical engineer in charge of production of the Kirby Equipment Company, Chicago, which position he held until 1912 when he became sales manager of the Northwestern Malleable Iron Company, with headquarters in Chicago.

G. A. Woodman

Charles A. Swan has been appointed assistant manager of steel sales at the Timken Roller Bearing Company, with headquarters at Canton, Ohio.

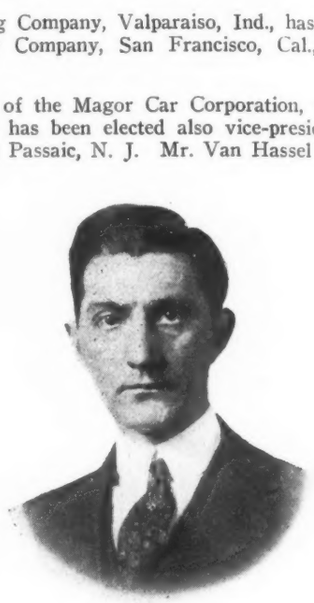
The Bettendorf Company, Bettendorf, Iowa, plans the construction of a three-story office building 76 ft. by 137 ft., to cost approximately $175,000.

The Welding Service & Sales Company, Donovan building, Detroit, Mich., of which T. M. Butler is manager, has been appointed agent in the Detroit territory for the Gibb Welding Machines Company, Bay City, Mich., for its arc, spot and seam welding machines.

A. H. Beale, president of the Lebanon Iron Company, Lebanon, Pa., has resigned to become president of the A. M. Byers Company, Pittsburgh, Pa.

The McGill Manufacturing Company, Valparaiso, Ind., has appointed the J. G. Pomeroy Company, San Francisco, Cal., its Pacific coast representative.

A. Van Hassel, secretary of the Magor Car Corporation, with headquarters at New York, has been elected also vice-president. The company's works are at Passaic, N. J. Mr. Van Hassel was born on November 12, 1889, in Paterson, N. J. He received his education in the grammar and high schools of that city. His first position was with the Rogers Locomotive Works. He subsequently entered the service of the Cook Locomotive Works in Paterson, N. J. Mr. Van Hassel became associated with the Magor Car Corporation in 1909, and served in various capacities until 1921 when he was elected secretary. Mr. Van Hassel is also assistant treasurer and assistant secretary of the National Steel Car Corporation, Hamilton, Ontario.



A. Van Hassel

The John H. McGowan Company, Cincinnati, Ohio, has bought the Twinvolute Pump & Manufacturing Company, Newark, N. J., builders of centrifugal pumps.

The National Malleable & Steel Castings Company, Cleveland, Ohio, has moved its Chicago sales office from 311 Railway Exchange to 501 Railway Exchange.

John Luther Nicholson, president of the Locomotive Firebox Company, with headquarters in Chicago, died on March 23 of pneumonia. Mr. Nicholson, who was born on June 25, 1875, in New York, was first employed at Chicago assisting his father, who was master mechanic on the South Side Elevated Railroad Company at the time of its construction. In October, 1895, he entered the employ of the Chicago & North Western as a locomotive fireman on the Wisconsin division. Later he worked extra in the same position on the Galena division. In July, 1902, he was promoted to engineman and in 1903 was promoted to assistant road foreman of engines on the Wisconsin division. He held this position until April, 1905, when he became associated with the American Locomotive Equipment Company, Chicago, to handle the sale of hollow arches for locomotives, of which he was one of the inventors. Later he entered business for himself to handle the sale of appliances which he invented. In 1918 he invented the thermic syphon and organized the Locomotive Firebox Company, taking charge of its manufacture and sales as president.

J. L. Nicholson

J. J. Flaherty, formerly in charge of welding for the Boston Elevated Railways, has been appointed director of sales of the Page Steel & Wire Company, with headquarters at Bridgeport, Conn.

The Yost Manufacturing Company, Meadville, Pa., has opened an office and warehouse at 25 South Jefferson street, Chicago, with H. S. Huncke in charge.

H. B. Warren, Cincinnati sales representative of the Thomson Electric Welding Company, has been made sales manager of the company, with office at Lynn, Mass.

E. H. Batchelder, Jr., Lytton building, Chicago, has been appointed western railroad representative of the varnish and enamel division of the Beaver Products Company.

The General American Tank Car Corporation and the General American Car Company have moved their general offices from the Harris Trust building to the Illinois Merchants Bank building, Chicago.

W. L. Bryson, formerly district manager of the Beaver Products Company, Kansas City, Mo., has been appointed manager of the St. Louis division of the Celotex Company, with headquarters in St. Louis, Mo.

H. F. Welch, in charge of railroad sales of the Niles-Bement-Pond Company, New York, has been appointed sales manager of the New York district. Mr. Welch will also continue to perform his former duties.

The Union Railway Equipment Company, Chicago, has discontinued its sales arrangement with Hope E. Scott & Co., Ltd., of Montreal, Que., and in future until further notice all Canadian business will be handled direct from the general offices, Chicago.

William Bonn, formerly assistant general sales manager of the auto body plant of the Pullman Company, has been appointed assistant general manager of the W. M. Laylor Company, railway sales representatives of the Zapon Company, with headquarters at Chicago.

W. R. Quinn, former manager of the fuel oil department of the Combustion Engineering Corporation, New York, has been appointed Pacific Coast agent, with headquarters at San Francisco, Cal. Mr. Quinn's territory will include Washington, Oregon and California.

Harry A. Flynn, who has served as general air brake supervisor of the Delaware & Hudson since 1904, has been appointed mechanical representative of the New York Air Brake Company in the New England territory, with headquarters at Boston, Mass. He succeeds N. A. Campbell, deceased.

C. E. Shearer has been appointed advertising manager of the Industrial Works, Bay City, Mich., and A. R. Olsen has been placed in charge of the art department. It was erroneously stated in the February issue of the *Railway Mechanical Engineer* that Mr. Olsen had been appointed advertising manager.

Allan M. Cullum has been appointed to the sales force of the Reading Iron Company, Reading, Pa. His headquarters will be at the general office of the company in Reading. R. I. Fretz has been placed in charge of marketing boiler tubes. Mr. Fretz formerly represented the Bethlehem Steel Company and the Midvale Steel & Ordnance Company for a number of years. He has been a student of metallurgy and metallography and spent some time in the Reading Iron Company's plant with a view to securing a working knowledge of its methods.

The Whiting Corporation, Harvey, Ill., has appointed new sales agents as follows: Snyder Foundry Supply Company, Los Angeles, Cal.; S. G. Elbe, Inc., 211 Tramway building, Denver, Colo.; Edward S. King, 306 Elmhurst building, Kansas City, Mo. Bradford H. Whiting, vice-president and general manager of the company, and president of its subsidiary, the Grindle Fuel Equipment Company, on account of ill health has resigned and severed his connections with these companies. Mr. Whiting has also given up his directorship in both companies.

Harry W. L. Porth, assistant master car builder of Swift & Co., Chicago, and president of the Chicago Car Foremen's Association died on March 2 in Chicago. Mr. Porth was born on January 18, 1889, in Utica, Kans. He entered the employ of Swift & Co. in April, 1912, as an engineer in the mechanical department at Kansas City, Mo. During the next few years he was promoted to assistant master mechanic and was transferred to the car department, Chicago, as a sub-foreman. In December, 1917, he was promoted to assistant master car builder, which position he held until his death.

Trade Publications

PINCH BUG RIVETERS.—Bulletin R-202, illustrating and describing Shepard pinch bug riveters, has been issued by the Hanna Engineering Works, Chicago.

STORAGE TANKS.—A 12-page folder descriptive of cast iron storage tanks for all industries where storage and materials transfer are needed, has been issued by the Conveyors Corporation of America, Chicago.

WELDING ELECTRODES.—The characteristics and applications of three types of welding electrodes, designated as Types A, B and C, are described in a 16-page illustrated booklet, entitled "G. E. Welding Electrodes," which has been issued by the General Electric Company, Bridgeport, Conn. Brief instructions covering the use of each type are also given.

MACHINERY AND TOOLS.—General catalogue, No. 138, listing a complete line of machinery, tools, cutters, attachments, etc., has been issued by the Brown & Sharpe Manufacturing Company, Providence, R. I. Each piece of equipment is illustrated, and detailed descriptions as well as tabulated specifications and dimensions are given. The catalogue contains over 600 pages and is of a convenient pocket size.

STEEL PRESERVATIVE PAINTS.—A 24-page, illustrated booklet has been issued by Toch Brothers, New York City, which describes the various forms of steel preservative paints which this company manufactures. The text matter includes a detailed description of each of the various kinds of paints, the purpose for which it is best fitted, and the recommended manner of applying it. This subject-matter is indexed at the back of the booklet with general headings covering types of construction and character of surface. The illustrations show a variety of structures protected by the paints of this company.

DRINKING WATER APPLIANCES.—Sanitary drinking water appliances manufactured particularly for railroad service by the Henry Giessel Company, Chicago, are described in a fully illustrated, 29-page catalogue, recently issued by this company. The catalogue is in loose leaf form so that new bulletins issued by the company can be readily included from time to time and the catalogue thus kept up to date. Sanitary drinking water coolers, filters, cooling apparatus and auxiliary appliance are described in the catalogue. A full page is devoted to the attractive monogrammed name plate which the company provides with all equipment.

PLIBRICO FURNACE LINING.—The Plibrico Jointless Firebrick Company, Chicago, has issued a 36-page catalogue of standard filing size, 8½ by 11 in., a large section of which is devoted to the proper installation of monolithic furnace linings. This section, step by step, tells how monolithic linings should be installed. Another section gives the reasons for the superiority of this type of furnace lining over other and less modern types. Sections describe the use of this lining for furnace fronts, arches, side walls, and bridge walls in boiler furnaces and for heating furnaces, baking ovens, stills and other industrial furnace and miscellaneous applications. There is an interesting section on lining furnaces under oil-burning boilers.

DUMP CARS.—Facts covering three basic designs of dump cars: the first, a car of the lifting door type; the second, a car of the lifting door type in combination with an outward folding chute, and the third, a car with an outward folding door, making the door of the car when in a dumped position a continuous slope in conjunction with the floor, are contained in Catalogue D, a neatly arranged booklet of 22 pages which has been published by the Magor Car Corporation, New York. Each of these three basic designs, subdivided into different cubical and weight capacities, depending on the service for which they are required, are illustrated in both loading and dumping positions. Lists of specialties with which the cars are equipped and specifications accompany the illustrations. Inserted between each page of descriptive data are blue print drawings showing details of construction. The cars, which are of the automatic or hand operated type for standard or narrow gage roads, are built for railroad, mining, contractors or industrial service.

Personal Mention

General

Robert Draycott has been appointed traveling fireman of the Central division of the Central of New Jersey.

W. C. Smith has been promoted to assistant to the chief mechanical officer of the Illinois Central, a newly created position.

R. J. Howard has been appointed superintendent of shops of the Pacific Fruit Express at Colton, Cal., succeeding James King.

W. H. Bender, shop superintendent of the Missouri Pacific at St. Louis, Mo., has been appointed mechanical inspector, with the same headquarters.

George G. Lynch, chief draughtsman of the Atlantic Coast Line, has been appointed assistant mechanical engineer, with headquarters at Wilmington, N. C.

L. E. Cartmill, superintendent of shops of the Pacific Fruit Express, with headquarters at Los Angeles, Cal., has been promoted to assistant general superintendent of the car department, with headquarters at San Francisco, Cal.

E. L. Johnson has been appointed assistant engineer of materials and equipment tests of the New York Central, his former positon—that of engineer of service tests—having been abolished and its duties taken over by E. C. Hardy, general inspector.

H. S. Peck, train lighting maintainer of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., has been promoted to supervisor of locomotive and power plant operation, with headquarters at Chicago, a newly created position. Mr. Peck was born on March 27, 1889, at Roy, Mont., graduating from Montana State College in electrical engineering in 1911. He entered railway service as a draftsman, inspector and designer in the electrification department of the Chicago, Milwaukee & St. Paul, in which position he remained until the fall of 1917, when he entered the United States Army, serving in France on the technical staff of Chief of Engineers of A. E. F. Department of Construction and Forestry, until July, 1919. Mr. Peck re-entered railway service in the office of the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, being appointed train lighting maintainer on January 1, 1924, which position he held until his recent promotion to supervisor of locomotive and power plant operation.

F. H. Adams, whose promotion to mechanical valuation engineer of the Atchison, Topeka & Santa Fe, with headquarters at Topeka, Kans., was reported in the February issue of the *Railway Mechnical Engineer*, was born on April 15, 1868, in Mississippi. He attended the University of Minnesota from 1885 to 1887, entering railway service in September of the latter year as a special apprentice on the St. Paul & Duluth, now a part of the Northern Pacific. He entered the service of the Gulf, Colorado & Santa Fe in February, 1891, in the office of the superintendent of machinery. He was promoted to engineer of shop extensions in November, 1901, and held that position until February, 1914, when he resigned to enter the Bureau of Valuation of the Interstate Commerce Commission. Mr. Adams returned to the Atchison, Topeka & Santa Fe in November, 1921, being assigned to special work in connection with the settlements with the Railroad Administration for under-maintenance of equipment during the period of federal control. He was later promoted to mechanical valuation assistant, which position he held until his recent promotion to mechanical valuation engineer.

Master Mechanics and Road Foremen

G. H. Warning has been appointed master mechanic of the Canadian National, with headquarters at Regina, Sask.

John B. Starbuck has been appointed road foreman of engines of the Sacramento division of the Southern Pacific, with headquarters at Roseville, Cal.

George B. Weller has been appointed assistant road foreman of engines of the Central division of the Central of New Jersey, with headquarters at Jersey City, N. J.

W. F. Laure, general foreman of the Illinois Central, with headquarters at Memphis, Tenn., has been promoted to master mechanic to succeed O. A. Garber, resigned to accept service with another company.

Henry C. Stevens has been appointed master mechanic of the Alamosa division of the Denver & Rio Grande Western, with headquarters at Alamosa, Colo. Mr. Stevens was born at Camden, S. C., on July 2, 1876. He attended the Waycross, Ga., high school and completed a mechanical course in the C-5000 class of the International Correspondence School of Scranton. He entered the Plant System shops as a machinist apprentice at Waycross in November, 1890. He then served as inspector of pumps and elevators from Savannah, Ga., to Jacksonville, Fla., on the Brunswick & Western, and as machine foreman at Waycross. In 1901 he became general foreman of the Atlantic Coast Lines at Montgomery, Ala.; in 1903, mechanical draftsman of the Gillon Machine Company at Waycross; in March, 1905, general foreman of the Montgomery district of the Mobile & Ohio, and in March, 1910, master mechanic of the Denver & Rio Grande at Alamosa. In March, 1918, he was transferred to the Burnham shops at Denver, Colo., serving as shop superintendent throughout the war period and the building of new shops at that point. He returned to the Alamosa division as master mechanic on February 15.

H. C. Stevens

Obituary

F. L. McClennan, foreman of the brass shop, rolling stock department, of the New York Central at West Albany, N. Y., died on February 20. Mr. McClennan entered the employ of the New York Central in March, 1901, as foreman of the brass shop.

John Howard, superintendent of motive power of the New York Central, with headquarters at New York, died suddenly on March 24. Mr. Howard entered the railway service as a machinist apprentice on the Pennsylvania at Renovo, Pa., and from 1883 to 1884 was successively machinist apprentice and locomotive inspector on the New York, West Shore & Buffalo (now a part of the New York Central) at Kingston, N. Y. From 1884 to 1891 he was foreman of the enginehouse of that road at Frankfort, N. Y. In 1891, he become general foreman; and in 1892 master mechanic of the River division of the West Shore at New Durham, N. J. He was promoted to superintendent of motive power and rolling stock of the Pennsylvania division of the New York Central at Corning, N. Y., in 1901 and, in 1902, became superintendent of motive power of the Western division of the same road at Depew, N. Y. From May, 1904, to November, 1904, he was superintendent of motive power and rolling stock of the Boston & Albany at Boston, Mass., and on November 1, 1904, became superintendent of motive power of the New York Central at New York.

J. Howard